

The DENTAL JOURNAL of AUSTRALIA

Contents

	Page		Page
ANTIBIOTICS—A REVIEW . . . E. Thomson	167	DENTAL MATERIALS: CURRENT NOTES	
		No. 27	210
SOME CLINICAL AND TECHNICAL ASPECTS OF PARTIAL DENTURES . . . J. H. Wilson	176	NEWS AND NOTES	211
ADAMANTINOMA IN RELATION TO TOOTH DEVELOPMENT E. B. Manley	184	ASSOCIATION ACTIVITIES	
MAKING THE MOST OF YOUR MATERIALS A. R. Docking	199	General Meetings	212
THE SELECTION AND DESIGN OF RE- TAINERS FOR EFFICIENT PARTIAL DEN- TURES H. P. Assheton-Chin	203	Extraordinary General Meeting	213
INFORMATION FROM THE DENTAL BOARD	208	Executive Report	213
EDITORIAL	209	Membership	214
		NEW BOOKS AND PUBLICATIONS	
		The Elements of Dental Therapeutics and Anaesthesia	214
		1953-1954 Series Year Book of Dentistry	214

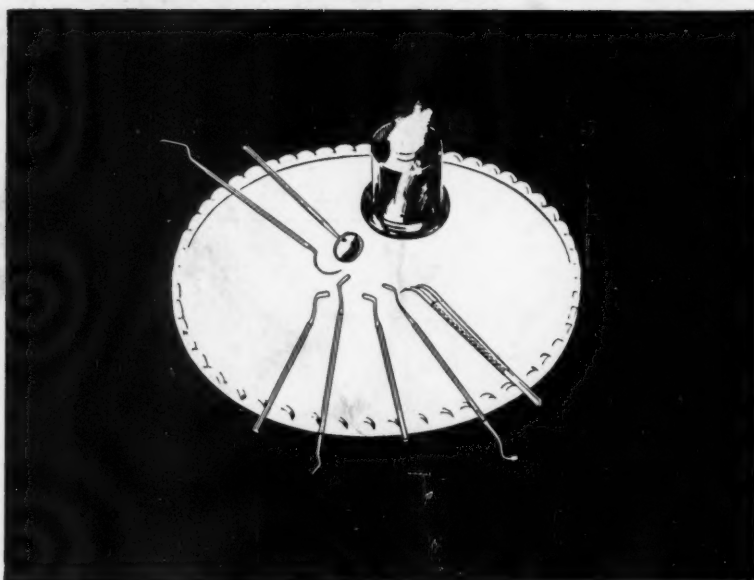


VOLUME 26

NUMBER 5

OCTOBER, 1954

Registered at G.P.O., Sydney, for Transmission by Post as a Periodical.



A circle of old friends . . . worth keeping!

Dentists, more interested to-day than ever before in prolonging the usefulness of their instruments, are turning in ever-increasing numbers to Metaphen Disinfecting Solution where the cold disinfection of instruments is practicable. For Metaphen Disinfecting Solution does not injure temper or finish, not pit or dull cutting edges, and thus eliminates the wear and tear of frequent resharping. • This widely used agent requires a minimum of attention and may be relied upon in the absence of much blood and exudate to kill common vegetative pathogenic bacteria (except tubercle bacilli) in about

ten minutes. Instruments removed from the disinfectant are ready for immediate use without rinsing or drying, since Metaphen Disinfecting Solution is non-irritating to the skin and oral tissues, and does not leave a gummy deposit to interfere with the free action of hinged or jointed instruments. • In addition, when instruments are cleaned before immersion, the solution remains clear and stable, and may be used over an extended period without marked decrease in efficiency. • Why not order a supply to-day?

ABBOTT LABORATORIES
(Australia) Pty. Limited
Box 3698 G.P.O. Sydney

Metaphen Disinfecting Solution

REG. TRADE MARK

•(4-nitro-anhydro-hydroxy-mercury-orthocresol. Abbott)

AVAILABLE IN BOTTLES OF 40 AND 80 FLUID OUNCES

Say you saw it in "The Dental Journal of Australia"

Busch

**BUSCH & Co. ENGELSKIRCHEN
(BEZ. KÖLN)**

Say you saw it in "The Dental Journal of Australia"

*Each
a case
for*



JACKET CROWN



GINGIVAL THIRD



MOD



SIMPLE CAVITY

RAVOCAINE

AND

PROCAINE WITH NORDEFIN

THE TRULY *NEW* SPECIFIC FOR
RESTORATIVE AND OPERATIVE DENTISTRY

SO FAST . . SO DEEP . . SO SAFE . . SO CERTAIN

MANUFACTURED IN AUSTRALIA BY

COOK-WAITE
Laboratories

FOR

THE AMALGAMATED DENTAL (AUST.) PTY. LTD.

MELBOURNE • SYDNEY

Say you saw it in "The Dental Journal of Australia"

Announcing!

ZELEX

NEW PROCESS



**YOU JUST MIX
IT WITH WATER!**

+



★ Available in 12
unit packs with
water measure

BALANCED MIX - SNAP SET

SOLE WHOLESALE DISTRIBUTORS

THE AMALGAMATED DENTAL (AUSTRALIA) PTY. LTD.

MELBOURNE · SYDNEY

Say you saw it in "The Dental Journal of Australia"

Texton

*The tough, strong, durable, self-curing resin for filling
class III and class V cavities.*

Texton is not the panacea for all cavities, not a substitute for silicate in all cases. Texton is however tougher than silicate, resists abrasion better, should be used where silicate may fail because of its lack of toughness and resistance to abrasion.

Can be used with the matrix and the brush techniques.
Has a short matrix holding time — only 5 minutes.

Has a high compressive strength for a resin.

Volume change about the same as that of a silicate in 7 days.

Mouth breathing does not harm Texton.

Resistant to lipstick stain.

The Filling Porcelain Improved Colour Matching Guide may be used with Texton because the colours of F.P.I. and Texton are the same.

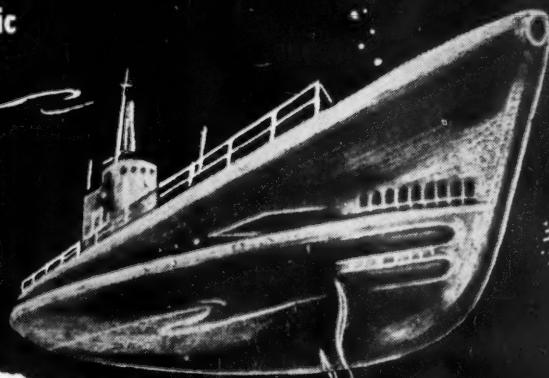


S. S. WHITE CO. OF AUSTRALIA PTY. LTD.
T. AND G. BUILDINGS, PARK STREET, SYDNEY

DEPTH WITHOUT DANGER

In an anesthetic

Safety
is the
First
consideration



Use Formula

2ME



MONOCAINE 2 per cent with Epinephrine 1:50,000

In Submarines "Depth without Danger" is of prime importance . . .

In local anaesthesia, too, we must consider the relationship between safety and depth. A number of anaesthetic drugs in excessive concentrations or combinations will produce deep anaesthesia. So will cocaine. But all of these "stronger" anaesthetics can induce toxic re-

action, and, in many instances, unpleasant post-operative sequelae.

Monocaine Formula 2ME (monocaine 2% with epinephrine 1 : 50,000), on the other hand, produces anaesthesia as deep as procaine 4%, yet its toxicity is appreciably less than that concentration of procaine.



Monocaine Formula 2ME was specifically developed for those cases in which anaesthesia is difficult to obtain. While Monocaine 1½% is recommended for routine use, Monocaine Formula 2ME will be found to be particularly advantageous for jacket crown work, pulp extirpation and the preparation of bridge abutments.

MONOCAINE Formula 2ME offers the anaesthetist depth without danger—it combines adequate potency with maximum safety.

Monocaine is the registered trade mark of the Novocol Chemical Mfg. Co., Inc.

**THE S. S. WHITE CO.
OF AUSTRALIA PTY. LTD.**

**T. & G. Building,
Park Street, Sydney**

Say you saw it in "The Dental Journal of Australia"



PRESTIGE

It was in the year 1846 . . . over one hundred years ago . . . Flavelle Bros. began business at 340 George Street, Sydney.

They were the first in Australia to make a study of the material requirements of the Dental Profession.

To-day—Flavelles Dental Pty. Ltd.—an organisation of experts who are always ready to make available to you the benefit of their years of experience. They will study your needs, make recommendations, and give you practical advice without obligation.

FLAVELLES

DENTAL PTY. LTD.
SYDNEY, MELBOURNE
and NEWCASTLE

For over 60 years
"Your Dental House"

Suppliers to the Dental Profession

Milne Browne & Co. Ltd.

Formerly called

BOSCH BARTHEL & CO. PTY. LTD.,

"DENTAL DEPÔT"

A Full and Complete Stock
of
EQUIPMENT, INSTRUMENTS, SUNDRIES
AND TEETH

Always on Hand

Orders Promptly Executed

- Situated at

Sydney:

114 Castlereagh Street,

2nd Floor,

Two Doors from Market Street,

Phone: M 4891 (4 lines)

Brisbane:

235 Edward Street,

Rowes Bldg.,

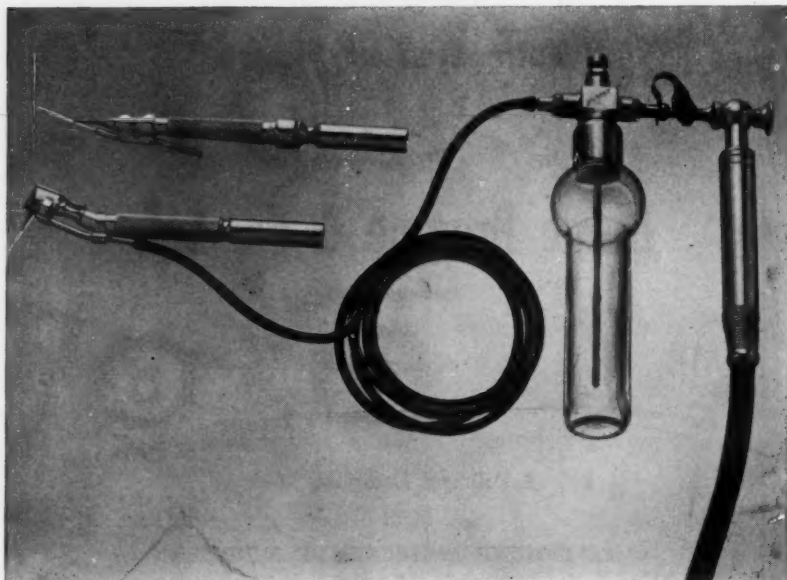
1st Floor,

Phone: B 6617, B 8761.

Telegrams: Milnebrowne.

Say you saw it in "The Dental Journal of Australia"

The Jendent Operative Spray



With the introduction of geared wrist-joints and high speed electric engines for the operation of diamond abrasives at an efficient speed of 12,000 r.p.m., it is essential that the abrasive be constantly cooled. The Jendent Operative Spray directs a stream of cooling spray directly to the TIP of the bur.

It also blows out all debris and allows the operator a constantly clear view of the cavity.

John T. Jennings Pty. Ltd.

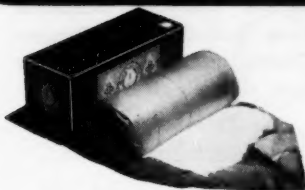
167 Elizabeth St., Sydney

Associated with

Jennings Elliotts Pty. Ltd., Brisbane.

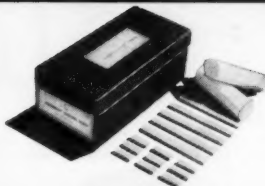
FOR *Dental* SURGERY

All Johnson & Johnson Dental products are of the highest quality and meet the most exacting requirements of the dental profession. Each product is backed by the reputation of the most trusted name in surgical dressings.



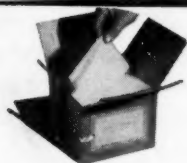
RED CHAIN COTTON:

The finest, most absorbent grade of surgical cotton, sterilised after packing. A long fibre cotton that elings together and is especially indicated for drying cavities and applying medicaments. Continuous paper inter-wrapping with overlapping protective edges facilitates handling without touching the cotton.



COTTON ROLLS:

Made of high-quality absorbent cotton—firm, compact, conforming readily to the mouth contour. Specially sized to prevent harshness of the outer skin. Available in $\frac{1}{4}$ " and $\frac{3}{8}$ " diameters. $1\frac{1}{2}$ " and 6" lengths.



DENTAL NAPKINS:

A cut gauze conveniently packed and specially suited for dental surgery. May be folded into Exodontia Sponges, used for wiping or polishing instruments after prophylaxis or as a mouth wipe. Packed in boxes of 500, in size 6" x 6".



COTTON PELLETS:

Sterilised, absorbent $\frac{1}{4}$ " Cotton Pellets afford considerable convenience in dental surgery. Perfect ready-made swabs of uniform size, shape, weight and absorbency.



ABSORBENT POINTS:

For the treatment of root canals and for absorbing blood, serum, pus or for the easy application of medicaments. Sterilised, in boxes of 200.



STERILE EXODONTIA SPONGES:

For use as a "bite sponge" after extractions or wherever an absorbent gauze is indicated in the mouth. Packed in sterile-sealed bags of 100 sponges for easy transfer to surgery dressing jar. In cartons of 10 bags.

PRODUCTS OF
Johnson & Johnson
PTY. LTD. SYDNEY

MELBOURNE • BRISBANE • ADELAIDE • PERTH • HOBART

Say you saw it in "The Dental Journal of Australia"

DENPRO DENTAL CHAIR

- The Queensland University Dental College, Brisbane, have installed 50 Denpro Chairs and Units in their new surgeries.



- A 12 months' Guarantee goes with each Chair.

Immediate Delivery from appointed agents in all states

Manufactured by

DENTAL PRODUCTS PTY. LTD.

196 ABBOTSFORD ROAD, MAYNE

BRISBANE

QUEENSLAND



AUSTRALIA

Say you saw it in "The Dental Journal of Australia"

Analgesic Therapy

TAB. CODEIN. Co. B.P.

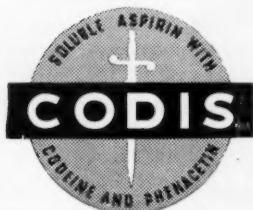
or

CODIS?

The manufacturers of 'Disprin' direct your attention to 'Codis' for all those conditions for which Tab. Codein. Co. B.P. would have been prescribed. Codis possesses marked advantages. The "aspirin" in Codis is soluble, as in 'Disprin'.

Placed in water, a Codis tablet provides, in a few seconds, a solution of calcium aspirin and codeine phosphate with phenacetin in fine suspension. The chance of gastric irritation is minimised because there are no undissolved particles of aspirin.

Other notable advantages of Codis, arising from the inclusion of aspirin in a stable and soluble form, are greater ease of administration and far less likelihood of intolerance by the patient. Being in solution, the aspirin is immediately available.



COMPOSITION

Each Codis tablet contains:—Acid Acetylsalicyl. B.P. 4 grs., Phenacet. B.P. 4 grs., Codein. Phosph. B.P. 0.125 grs., Calc. Carb. B.P. 1.2 grs., Acid. Cit. B.P. (Exsic) 0.4 grs., Excip ad. 11.45 grs.

DISPENSING PACKS Hospital bottle of 200 tablets. Prescription box of 100 tablets in 10 distinctive gold foils of 10 tablets each.

OTHER SIZES 16 tablets in 4 distinctive gold foils.

Codis is not advertised to the public
SAMPLE ON REQUEST

RECKITT AND COLMAN (AUSTRALIA) LTD. (PHARMACEUTICAL DIVISION) SYDNEY

Say you saw it in "The Dental Journal of Australia"

WELCOME PROTECTION

All Sickness and Accident Cover



£10, £15, or £20 per week for disablement by any sickness or accident.

Special protection for forefingers and thumbs.

Life and Endowment Policies also issued incorporating all sickness and accident cover.

For full list of many benefits write or phone

The Australian Provincial Assurance Association Ltd.
Incorporated in New South Wales

53 MARTIN PLACE, SYDNEY

BW 4201 (5 lines).

Say you saw it in "The Dental Journal of Australia"



Pain

is the last straw that breaks the patient's fortitude.

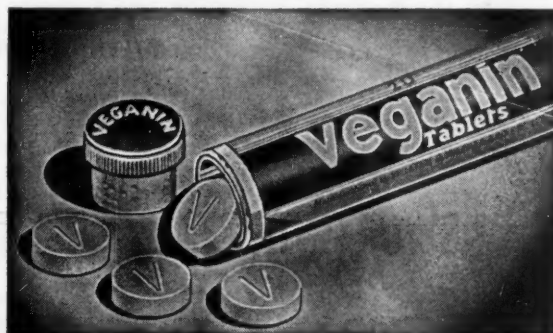
The more promptly he can be relieved of pain the greater will be his appreciation and the more lasting his confidence in the dentist.

VEGANIN serves as a satisfactory and comprehensive treatment for all types of dental pain, and it may be used profitably as a sedative before extractions.

Therapeutically considered, Veganin fills a well-defined need in dental practice.

Veganin Tablets are supplied in tubes of 10 and 20 tablets.

Quantities of 100 tablets are available for Professional use.



**WILLIAM R. WARNER & CO. PTY. LTD.,
508-528 RILEY STREET, SYDNEY, N.S.W.**

Say you saw it in "The Dental Journal of Australia"

The Choice CAN ONLY be New Classic Teeth

Today, the practitioner has a wide and varied choice in acrylic teeth, and the selection of one particular manufacture which conforms to the specific requirements of modern prosthetic dentistry would appear to be a difficult task.



However, the outstanding qualities of New Classic Teeth put them in a class by themselves, and for the discerning practitioner, the choice **can only** be *New Classic*.

The range of moulds and shades cover every possible need, whilst the structural perfection and accuracy in the blending of the pigments ensures functional and aesthetic qualities second to none.

*New Classic Teeth are obtainable throughout Australia from your usual dealer
or from*

UNSWORTH DENTAL SUPPLIES (A'SIA)

PTY. LTD.

55 COLLINS PLACE, MELBOURNE.

Say you saw it in "The Dental Journal of Australia"

Aristaloy

THE SCIENTIFIC
AMALGAM ALLOY

HOMOGENISED

- 1 ARISTALOY has an extremely low but very necessary zinc content of less than $\frac{1}{2}$ of 1% (A.D.A. Specifications allow up to 2%). Thus, any possibility of over-expansion which could cause post-operative shock or leaking margins is practically eliminated.
- 2 ARISTALOY'S very low plastic flow of 1.4 per cent (A.D.A. allows up to 4%) is equivalent to approximately 50,000 lbs. crushing strength. Natural tooth structure has an approximate crushing strength of 30,000 lbs. per sq. in.
- 3 ARISTALOY'S patented assorting equipment which daily accepts and rejects millions upon millions of particles of alloy, enables you to build much denser fillings which remain bright and clean in the mouth—with sealed margins and edge strength never before thought possible!

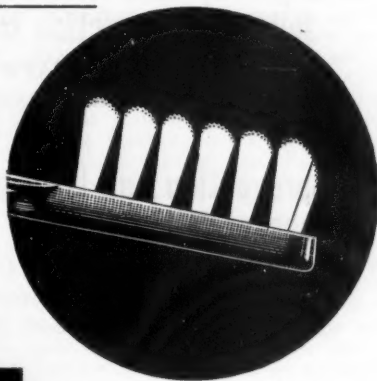
Obtainable from your Dental Depot.

Sole Australian Distributors:

GLOVER & GOODE PTY. LTD.
Dental Manufacturers, Melbourne.

ENGELHARD

NOW
AVAILABLE
IN
**NATURAL
BRISTLES
NADA**



THE DENTISTS'-DESIGN TOOTHBRUSH
AT CHEMISTS EVERYWHERE

Say you saw it in "The Dental Journal of Australia"

For the relief of pre- and post-operative pain

ANGESIL (D.H.A.)

Tablets of aspirin, phenacetin and codeine.

For the prevention of infective "flare-up" following extraction

***PROCILLIN A.S.** An aqueous suspension of procaine-penicillin G, packed in either triple-sealed silicone treated vials, disposable syringe or cartridge (which can be used with standard dental cartridge syringe).

In vials of 400,000, 600,000, 900,000, 1,000,000 or 1,500,000 units.

In disposable syringe of 900,000 or 1,000,000 units.

Injecs (cartridges): Procillin Injecs 900,000 units.

***PROCILLIN DRY FORT.** The addition of sterile double distilled water produces a suspension ready for injection.

In vials containing 600,000, 1,200,000 or 1,500,000 units.

***PROCILLIN FORT (OILY).**

Injecs of 600,000 units.

In disposable syringes of 600,000 and 1,000,000 units.

*Registered trade mark.

As a prophylactic where excessive haemorrhage following extraction is feared

ACETOMENAPHTHONE (D.H.A.)

(Vitamin K) in tablets of 5 and 10 mg.

For prevention and treatment of post-operative socket infection

AUREOMYCIN DENTAL CONES

Each cone contains aureomycin hcl. crystalline 5 mg.,
benzocaine 1 mg. Tube of 12 cones.



***Distributed throughout Australia by
All D.H.A. Houses***

Special Article

Antibiotics — A Review

Edgar Thomson*

It is quite impossible in the space of a review article to deal completely with all aspects of all known antibiotics. It is intended therefore to give firstly a brief outline of the history of the discovery and development of antibiotics and then to deal in particular with those antibiotics which are in common daily use and about which there is considerable knowledge.

It has been known for many years that some bacteria and moulds interfere with the growth of other micro-organisms. In 1877 Pasteur and Joubert in describing experiments on the growth of *Bacillus anthracis* suggested that this antagonism might be of value for therapeutic purposes. In 1899 Emmerich and Loew reported that experimental anthrax could be cured by the local application of a liquid containing "pyocyanase," an enzyme produced in the culture medium in which *Pseudomonas pyocyanea* had been grown. Since then many suggestions have been made from time to time that therapeutic use might be made of the antibacterial products of the metabolism of bacteria and moulds, but Penicillin was the first such product to be purified and used on a large scale in the treatment of disease processes due to bacterial activity.

Professor Sir Alexander Fleming of St. Mary's Hospital, London discovered penicillin in 1929. His discovery was actually an accident—an accident described by Sir Howard Florey in a lecture given in 1943 as quite one of the luckiest accidents that have occurred in medicine, for without exception all other mould antibiotics so far examined are poisonous. The accident occurred while Sir Alexander Fleming was investigating the destruction of bacteria by leucocytes. An agar plate on which staphylococci were growing became contaminated by an airborne mould which was subsequently identified as *Penicillium notatum*. This is an uncommon species of *Penicillium*. Fleming noticed that in the neighbourhood of the mould the colonies of staphylococci had undergone lysis. He investigated this action further by growing the mould in a peptone

broth medium which was then filtered. The filtrate was found to inhibit the growth of certain bacteria even when diluted 800 times and it was to this medium after filtration, that Fleming gave the name "penicillin". Raistrick and his colleagues at the London School of Hygiene and Tropical Medicine endeavoured to isolate the active principle. Under the conditions which they used they found penicillin to be an extremely unstable substance. Partly because of the difficulties encountered by Raistrick and his colleagues, and perhaps partly because of the introduction of the sulphonamides about 1933, work on penicillin more or less ceased until in 1938 Florey and his colleagues decided to work on antibacterial substances produced by bacteria and fungi. They eventually narrowed down to two, the organisms which they proposed to investigate—*Pseudomonas pyocyanea* and *Penicillium notatum*. Three antibacterial substances were obtained from *Pseudomonas pyocyanea* but these were found to be toxic and so they finally chose penicillin which had practically no toxic effect. In the years 1940-1942 the work of Florey and his colleagues proved beyond doubt the immense value of penicillin in the treatment of diseases due to certain organisms; and so began a new era in the treatment of disease.

In 1939 Dubos in the United States of America reported the antibacterial activity of an organism isolated from soil and subsequently identified as *Bacillus brevis*. The antibiotic, tyrothricin, was first isolated from the culture filtrate as a complex with protein but later free tyrothricin was obtained. Further work resulted in the separation of tyrothricin into two active crystalline substances—gramicidin and tyrocidine.

In 1942 Waksman and Woodruff reported the isolation of Streptothricin from a culture of *Actinomyces lavendulae*. This substance was too toxic for therapeutic use. In 1944 Waksman and his colleagues announced the isolation of a new antibiotic which they called Streptomycin. This substance is produced by *Streptomyces griseus*, a member of the widely distributed group of micro-organisms known

*Fairfax Institute of Pathology, Royal Prince Alfred Hospital, Sydney.

as actinomycetes. Clinical trials soon established that streptomycin was effective against many pathogenic bacteria, including *Mycobacterium tuberculosis*, which were resistant to penicillin and the sulphonamides.

In 1945 Meleney and Johnson isolated a gram positive sporulating bacillus of the *B. subtilis* group from a compound fracture of the tibia. By growing this organism in a suitable medium they produced an antibacterial substance to which was given the name Bacitracin.

Following the isolation of streptomycin investigations continued into the production of antibiotics by the actinomycetes and in 1948 Duggar working in the Lederle Laboratories Division of the American Cyanamid Co. announced the discovery of an antibiotic from a new species of this group of organisms. Because of the yellow colour which developed in the fungus during growth and the golden yellow colour of the antibiotic the name *Streptomyces aureofaciens* was given to the organism and the antibiotic was called aureomycin; (now known to be chlortetracycline).

The discovery of aureomycin heralded a new era in antibiotic therapy. Compared with the antibiotics already discovered aureomycin was shown to have a very broad spectrum of activity in that it was effective against numerous gram positive and gram negative organisms as well as against some rickettsiae and perhaps against some of the larger viruses. It also had a low toxicity. Further it could be administered orally, whereas previous antibiotics had to be administered by injection to achieve a proper therapeutic level in the blood stream.

Further antibiotics were then discovered in rapid succession. In 1947 a group of workers in the research laboratories of Parke, Davis & Co. at Detroit, U.S.A., in conjunction with Dr. Paul Burkholder a botanist from Yale University discovered chloromycetin which was obtained from a hitherto unknown species of *Streptomyces* isolated from a sample of soil from a field in Venezuela. The organism is closely related to the streptothricin-producing *Streptomyces lavendulae* and from its origin it was named *Streptomyces venezulae*. This antibiotic is unusual in that it is a derivative of nitrobenzene and of dichloroacetic acid, a substance not previously found in a natural product. The registered trade name of the antibiotic is CHLOROMYCETIN and the generic name Chloramphenicol. This antibiotic is the first major antibiotic to be synthesised commercially. It was shown to be effective when given orally against a large number of gram negative organisms

and some gram positive organisms as well as against rickettsiae.

In January 1950, Finlay and co-workers from the laboratories of the Pfizer Company in New York announced the discovery of another broad spectrum antibiotic Oxytetracycline (tetracycline) which was obtained from a new species of actinomycete—*Streptomyces rimosus*.

The search for new antibiotics goes on continually. Samples of soil from all parts of the world are cultured in the hope that new strains of streptomycetes or other fungi will be found which will give new and still more effective antibiotics. As a result of this constant search many hundreds of antibiotics are discovered but unfortunately the great majority of these are too toxic to be used as therapeutic agents.

Some of the antibiotics which have been added to the list are the Polymyxins which are produced from the fermentation liquors in which *Bacillus polymyxa* (*Bacillus aerosporus*) has been grown. There are five polymyxins A to E. Polymyxin A was known formerly as aerospirin. Polymyxin B is useful against *Pseudomonas pyocyanea*; but the polymyxins are extremely toxic having an effect on the kidney and the central nervous system and have therefore to be used with great care.

Neomycin obtained from *Streptomyces fradii* is another toxic antibiotic which is used topically but rarely parenterally; Viomycin obtained from either *Streptomyces puniceus* or *Streptomyces floridus* is active against streptomycin resistant strains of *Mycobacterium tuberculosis*. Many other antibiotics are still in the experimental stage.

Two new antibiotics which have come into limited use since 1953 are Erythromycin (Ilotycin, Erythrocylin) obtained from *Streptomyces erythreus* and Carbomycin (magnamycin) obtained from *Streptomyces halstedii*. These antibiotics have a spectrum very similar to that of penicillin.

In addition to the search for new antibiotics, improvement in the preparation and structure of the older antibiotics is always the subject of investigation in an attempt to minimise the toxic effects which may follow administration. Recently Chlortetracycline (aureomycin) and Oxytetracycline (tetracycline) have been altered to Tetracycline which is said to have less side effects. Tetracycline is known by the trade names of ACHROMYCIN (Lederle) and TETRACYN (Pfizer).

The antibiotics in general use at the present time are (1) Penicillin, (2) Streptomycin, (3)

the "broad spectrum" antibiotics, Chlortetracycline (aureomycin), Oxytetracycline (terramycin), Tetracycline (achromycin and tetracyclin), and Chloromycetin (chloramphenicol). Antibiotics which are in limited use are Polymyxin B, Neomycin, Bacitracin, Viomycin, Erythromycin and Carbomycin.

Before giving the detail of the antibiotics now in general use it might be well to mention facts which are common to all antibiotics.

1. *Mode of Action.*

The mode of action of the antibiotics is complex and in many cases not yet clearly understood. It is sufficient in this context to say that the action is some interference with or alteration of the complex biochemistry of the organisms which either destroys the organism or inhibits its growth. These antibiotics which destroy the organism are called bactericidal and the chief of these are penicillin and streptomycin. Those antibiotics which only inhibit the growth of the organism are called bacteriostatic and the broad spectrum antibiotics come into this category.

2. *Mode of Administration.*

Antibiotics may be given by injection (intramuscularly, subcutaneously, intravenously or into body cavities), orally or topically. The route of administration varies with the antibiotic chosen and with the severity of the disease. Penicillin is nearly always given by intramuscular injection. On rare occasions it may be given intravenously and to a limited extent orally. Topical application has been almost entirely discontinued. Streptomycin is given by intramuscular injection and sometimes is applied topically. The "broad spectrum" antibiotics are usually given by mouth. In severe illness they may be given intravenously for a limited period. Intramuscular preparations are also available and topical application is quite common. Neomycin and bacitracin are limited to topical application. Polymyxin is given intramuscularly as is Viomycin.

3. *Dosage.*

Dosage must vary with the antibiotic, the route of administration and the severity of the disease. It is possible to lay down basic standards of dosage which can then be altered to meet individual needs. Even these basic standards are subject to some variation in various parts of the world. The basic standards given later in this review are those generally accepted in this country.

4. *Choice of Antibiotic.*

The antibiotic must be chosen after careful consideration and will depend on the nature of the infecting organism and its antibiotic sensitivity. The fact that antibiotic resistant strains of certain organisms develop readily and sometimes with great rapidity is now well established. Thus it is essential whenever possible to have full bacteriological control of antibiotic therapy both in regard to the isolation of the infecting organism and the determination of its antibiotic sensitivity before and during treatment.

The nature of the infection cannot be taken as a guide to the identity of the infecting organism. For example meningitis, pneumonia, septicaemia, peritonitis and urinary infections may be caused by a variety of organisms. Boils and gonorrhoea are exceptions but even in these conditions and especially in boils the organism may show resistance to one or more of the antibiotics. Fairbrother, Martyn and Parker (1951) have studied the bacterial flora in cutaneous infections including localised cellulitis, in infections associated with the respiratory tract, in urinary infections, in deep abscesses and the organisms isolated from blood culture. The results of their investigation showed clearly the variety of infecting organisms and the varieties of sensitivity which may be encountered.

Cultures are made either from pus, from body fluids, from throat swabs, nasal swabs, wound swabs, from blood culture, from urine and from faeces depending on the nature of the case and it is the responsibility of the bacteriologist to advise the clinician as to the best material for examination.

Micro-organisms may be either naturally resistant to antibiotics or they may develop such resistance. The incidence of strains of organisms which have developed resistance has increased rapidly in recent years especially in the case of *Staphylococcus pyogenes* and the Gram-negative bacilli.

The problem of antibiotic resistance does not arise with all organisms but even in the case of the more highly sensitive organisms such as *Streptococcus pyogenes*, *Streptococcus pneumoniae* and *Neisseria gonorrhoea* resistant strains are now beginning to appear. It is therefore important that the antibiotic sensitivity of the infecting organisms should be determined as a routine.

There are various technical procedures used in sensitivity tests, the tube dilution method and the impregnated disc method being the two which are most commonly used. The serial dilution method is time consuming and not

readily applicable for use in a laboratory where large numbers of sensitivity tests are carried out each day. It would appear to be, however, if carefully performed and controlled rather more reliable than the impregnated disc method.

The impregnated disc method, because of its convenience and because with it large numbers of organisms can be tested quickly, is the most widely used. It is an adaptation of the original cylinder method. There are a variety of disc methods all of them basically the same, variations being chiefly due to individual preference. There are two main variations of the method. In one, discs impregnated with the different antibiotics are placed on a plate-culture seeded with the unknown organism. In the second only one impregnated disc is placed in the centre of each plate and stroke cultures are made from the margin towards the centre, three to four organisms being tested on each plate. A control organism is also cultured on each plate. It is felt that there is an advantage in this method in that the results of the unknown can be compared with the results of the control under identical conditions of the test.

Two types of impregnated disc are available—the "dry" disc and the "wet" disc. With the "dry" disc a measured quantity of antibiotic is placed on the disc and the disc allowed to dry. The disc can then be stored before use. There are "dry" discs marketed by commercial firms, but their accuracy is a matter of some doubt. With the "wet" disc, the disc is placed in a central position on the culture plate, a measured quantity of antibiotic is placed on the disc and the culture plate allowed to stand for a fixed time, e.g., 15 minutes before use. Whichever type of disc is used it seems preferable that the discs should be prepared in the laboratory in which the tests are being carried out.

The amount of antibiotic placed on each disc is of some importance, although this is subject to wide variation without any appreciable effect on the results. The following table shows the difference in quantities which have been used but which have given comparable

results. It is only when there is a great excess in the amount of antibiotic used that zones of inhibition may appear with relatively insensitive organisms.

There has been much discussion as to the validity of *in vitro* tests for antibiotic sensitivity. It must be admitted that most of the methods in use for sensitivity testing are not accurate. Jackson and Finland (1951) have shown that the results can be varied at will by altering one of the following factors (1) size of inoculum, (2) period of incubation, (3) choice of complete or partial inhibition as the end point of the tests. It would be necessary to control rigidly all test conditions if the results of one laboratory were to conform exactly with the results of another. Yet the figures for the incidence of antibiotic strains obtained in different laboratories using different technical procedures are remarkably comparable.

Discrepancies do occur between *in vitro* results and the subsequent clinical response. Spaulding and Anderson (1951) point out however that many factors in the host, such as adsorption, diffusion and excretion rate, must be taken into account in relation to *in vivo* effectiveness. They point out also that certain factors are known to be responsible for clinical failure in cases where the organisms were reported as antibiotic-sensitive. Such factors may be that the organism isolated was not the actual causal organism; the dosage may have been inadequate; the original susceptible bacterial flora may have been replaced by antibiotic resistant flora; mechanical or anatomical barriers may have been present to prevent the antibiotic from reaching the site of infection as in the case of a walled off abscess or the valvular vegetations of subacute bacterial endocarditis.

Some consider it sufficient to isolate the causal organism and select the antibiotic by clinical trial. This must surely be unsound and may waste valuable time.

There is unavoidable delay while bacteriological investigations are being carried out. If the organism is first cultivated and then sensitive tests are carried on with single colonies

	Thomson B.A.	Fairbrother & Martyn	Spaulding & Anderson	Thomson E.F.
	1950	1951	1951	1952
Penicillin ...	1,000 units per ml	55 units per ml	50 units per ml	500 units per ml
Streptomycin ...	10,000 µg per ml	1,000 µg per ml	500 µg per ml	20,000 µg per ml
Aureomycin ...	2,500 " " "	300 " " "	500 " " "	5,000 " " "
Chloromycetin ...	2,500 " " "	1,000 " " "	700 " " "	5,000 " " "
Terramycin ...	2,500 " " "	300 " " "	500 " " "	5,000 " " "

—a procedure which is very desirable—there will be a delay of some forty-eight hours. During this forty-eight hours the most likely suitable antibiotic can be given and at least at the end of the forty-eight hour period the suitable antibiotic has been determined. This forty-eight hour period may be reduced to twenty-four hours if sensitivity tests are carried out from the original swab or material submitted. This practice is adopted in many laboratories. Again if sufficient primary growth has occurred sensitivity tests may be made after 12-14 hours incubation and the results known in 24 to 36 hours. In a laboratory where there is a twenty-four hour service this practice might well be adopted. It must be remembered too that the disc method of sensitivity testing measures only the bacteriostatic activity of the antibiotic and not the bactericidal activity.

It is certain, that, even taking into account all the inadequacies of the various methods of sensitivity testing, it is very desirable to know the causal organism and its antibiotic sensitivity. It is felt also that whatever method is used it can be standardised in each laboratory and the result in that laboratory interpreted with a fairly high degree of accuracy. It is to this end that we favour the use of a control organism on each plate.

In dental practice as in medical practice bacteriological control is of paramount importance, and the collection of material for examination does not usually present any difficulty.

ANTIBIOTIC SYNERGISM AND ANTAGONISM.

The effects of combinations of antibiotics upon micro-organisms are of interest to the bacteriologist from the standpoint of mode of action and to the clinician from the standpoint of therapeutic efficacy. Although the field is new and unexplored a few clear-cut examples of synergism and antagonism are known.

Antibiotic Synergism.

The best example of antibiotic synergism is that in which penicillin and streptomycin are used against certain of the Gram-positive cocci, especially in subacute bacterial endocarditis due to *Streptococcus viridans*. Another example of synergism is seen in the use of streptomycin with chloramphenicol in the treatment of undulant fever. Synergism is also observed between bacitracin and penicillin against *Staphylococcus pyogenes* and recently the use of bacitracin and neomycin together has been recorded.

Antibiotic Antagonism.

It has been shown both *in vitro* and *in vivo* that there is antagonism between penicillin and the newer antibiotics, chloramphenicol, aureomycin and terramycin. The interference is always with penicillin. There is no evidence that penicillin interferes with the other antibiotics. It is not recommended therefore that penicillin be used with chloramphenicol, or the tetracyclines. The problem of antibiotic synergism and antagonism is very complex, but it is possible to divide the antibiotics into two groups;

Group 1 consists of penicillin, streptomycin, bacitracin and neomycin.

Group 2 consists of the tetracyclines and chloromycetin.

Drugs of Group 1 are often synergistic with each other and are never antagonistic. Drugs of Group 2 are never synergistic with or antagonistic to each other but may be additive, Group 2 drugs are often antagonistic to Group 1 drugs acting on Group 1 susceptible organisms. Group 2 drugs are sometimes synergistic with Group 1 drugs when acting on Group 1 resistant bacteria.

PROPHYLACTIC USE OF ANTIBIOTICS.

Although antibiotics are widely used prophylactically this practice is generally unwise. The main purpose in using antibiotics is to treat infection not to prevent it. The use of antibiotics prophylactically has been the subject of much discussion in recent medical literature and it seems proper to quote from the letter of Norman C. Lake, a London surgeon, in the British Medical Journal, December 13th, 1952:

This letter, therefore, is not a warning against the use of antibiotics and similar materials, but against their unthinking universal employment. One hears nowadays of operations being performed "under an umbrella of antibiotics." I don't like the metaphor, because umbrellas can obscure the sun as well as keep off the rain. To listen to some of our recently qualified doctors one would get the impression that no one recovered from infectious illnesses before the introduction of these new medicaments. In the casualty departments of hospitals particularly they are too lavishly used for quite trivial cases.

This, Sir, seems to me to be an abuse of some of the most valuable materials which the outcome of inspired research has placed in our hands. I hope that some restraint will be exercised in their employment in such circumstances and that it will be realized how completely they may obscure, in some instances, the development of quite serious complications.

The use of penicillin during dental manipulations in patients with valvular or congenital heart disease for the prevention of bacterial endocarditis is an accepted practice; but there is still great difference of opinion as to the dosage of antibiotics to be used, as to the actual timing of the administration in

relation to the dental procedure and as to the length of time either before or after such procedure that the antibiotic should be given. The difference of opinion arises because the reason for the prophylactic use of antibiotics in these dental procedures is not quite clear. If it is desired to eliminate the potential blood stream invaders from the dental foci then large doses of antibiotic would be necessary for a considerable time before the dental operation; and the duration of antibiotic therapy after the operation would depend on the efficacy of the administration before the operation. If however, it is desired to merely clear the blood stream of organisms which invade during the dental operation then a single relatively small dose given at or shortly before the operation would probably be sufficient.

The complete prevention of blood stream invasions from dental foci is not possible as simple procedures such as mastication of food and brushing of teeth may cause such invasion; and antibiotics cannot be administered throughout life. The use of a single small dose reduces the chances of an immediate bacteraemia and there is less chance of side effects and less chance of the suppression of the oral and dental flora and its replacement with antibiotic resistant strains of organisms which may ultimately cause endocarditis. The more prolonged treatment with larger doses may be more effective in reducing or eliminating dental infections but the side effects may be greater and of more consequence.

The final answer to the problem is not known. Cases of bacterial endocarditis have been recorded after dental extraction performed under a cover of antibiotics. There is no proof that the antibiotic cover has ever actually prevented bacterial endocarditis after dental extraction.

There is on record the fact that the patient who received the largest doses and for the longest period suffered endocarditis due to a most antibiotic resistant organism. If prophylaxis is considered necessary it may be wise to use an antibiotic different from the one which would be used to treat the endocarditis should it develop.

DANGERS OF ANTIBIOTICS.

The dangers arising from the use of antibiotics may be:—

(1) *Toxic effects.* It is known that chloromycetin can cause depression of the activity the bone marrow which may result in a simple leucopaenia agranulocytosis or aplastic anaemia. These toxic effects of chloromycetin are viewed with grave concern in the U.S.A.

In America the following statement appears on the labels of all formulas of chloramphenicol other than those used topically: "Warning. Blood dyscrasias may be associated with intermittent or prolonged use. It is essential that adequate blood studies should be made."

Streptomycin can cause vestibular and eighth nerve damage resulting in giddiness and deafness. These changes may be irreversible.

The tetracyclines may cause nausea, vomiting and diarrhoea, pruritus ani and pruritus vulvae.

(2) *Allergic reactions* such as urticaria, angioneurotic oedema, anaphylaxis, asthma and dermatitis. Such reactions are not uncommon after administration of penicillin and may come on seven to ten days after the administration has ceased. These reactions can be fatal.

(3) *The development of antibiotic resistant strains of organisms.* That organisms can and do develop resistance to agents with which they come in contact is well known and has been shown, for example, in the development of resistance to sulphonamides and to some antiseptics. Although it was not realized at first that antibiotic-resistant strains of previously sensitive organisms could develop, this fact is now well established. The incidence of antibiotic-resistant strains in hospital communities has reached an alarming level and presents a very difficult problem in relation to the treatment of patients and the control of cross-infection. It may well be that the indiscriminate use of antibiotics has been an important contributing factor to the present high incidence of these antibiotic-resistant strains.

It is fortunate that the problem of antibiotic-resistant strains does not arise with all organisms; but recent work has shown that, even in the case of organisms which have been regarded as free from antibiotic resistance, some resistant strains are now beginning to appear. The *Streptococcus pyogenes* has not shown antibiotic resistance until recently, when a few resistant strains have been found; but as yet there is no problem in relation to resistant strains of this organism. The position with *Streptococcus pneumoniae* is similar to that with *Streptococcus pyogenes*. The Gram-negative diplococci—*Neisseria gonorrhoeae* and *Neisseria meningitidis*—still remain antibiotic-sensitive, although resistant strains can be developed *in vitro*. The pathogenic Gram-positive bacilli are generally sensitive, although some penicillin-resistant strains of *Clostridium welchii* have been found.

The development of antibiotic-resistant strains of *Staphylococcus pyogenes*, of *Bacterium coli* and related Gram-negative bacilli, of *Proteus vulgaris* and of *Pseudomonas pyocyanea* presents the greatest problem, as the rapidly increasing number of strains of these organisms resistant to one or other or all of the antibiotics is being discovered.

Resistance of strains of *Mycobacterium tuberculosis* to streptomycin is well known.

It is not intended to discuss in detail the mechanism of the development of antibiotic-resistant strains of organisms. There appear to be three possible mechanisms: (i) strain selection, (ii) adaptation, (iii) mutation. There is evidence of strain selection, for example, with *Staphylococcus pyogenes*. When resistance develops in a bacterial population which was previously wholly sensitive, then there must have been either adaptation or mutation. The question is not yet wholly answered but there would appear to be strong evidence in favour of mutation.

It is certain that cross-resistance to more than one antibiotic does occur. This is particularly common with aureomycin and terramycin. Chloramphenicol may be involved. Gram-positive cocci and Gram-negative bacilli which develop resistance to aureomycin are very apt to develop resistance to terramycin. This has been shown *in vitro* and does occur *in vivo*.

The problem of the development of antibiotic-resistant strains of organisms has been studied in the Fairfax Institute of Pathology since 1948 by Dr. Phyllis Rountree, R. G. H. Barbour and myself. From October, 1948, to March 31, 1949, of 228 strains of *Staphylococcus pyogenes* examined 53% were resistant to penicillin and 5% to streptomycin. From April 1949, to March 31, 1950, of 603 strains examined 53.4% were resistant to penicillin and 14.0% to streptomycin. From January 1, 1951 to March 31, 1952, of 1049 strains examined 65.7% were resistant to penicillin and 29.5% were resistant to streptomycin. In February, 1952, 21 of 67 strains (31.3%) were resistant to aureomycin and terramycin. In March, 1952, eight of 67 strains (12%) were resistant to chloramphenicol. The latest figures show that the incidence of antibiotic-resistant strains of organisms in hospitals has remained at this level.

The incidence of antibiotic resistant strains of Gram-negative bacilli is equally alarming. From January 1, 1950, to March 31, 1951, of 838 strains of *Bacterium coli* tested 50% were resistant to streptomycin. The percentage resistant to aureomycin rose from 30.8% to

67.8%. Of 381 strains of *Proteus vulgaris* tested the incidence of streptomycin resistant strains has risen from 12.9% to 32.5%. The incidence of strains of *Pseudomonas pyocyanea* resistant to terramycin has risen from 52.6% to 71.0%.

PENICILLIN.

Penicillin is still the most effective and least toxic agent available for the treatment of most infections due to organisms which are moderately or highly sensitive to it *in vitro*. Some of its usefulness, however, has been reduced by excessive and unnecessarily widespread usage over the past few years, which has resulted in the sensitization of large numbers of individuals and, in the case of the staphylococcus, by the gradual elimination of sensitive strains. The general recognition of the increase in resistance of pathogenic staphylococci to penicillin in all hospitals and communities where this agent is used very extensively has also raised the obvious question of whether penicillin might be losing some of its effectiveness in other infections for which it is generally employed. The tendency to prescribe dosages which appear inordinately high and ever increasing in relation to the previously known sensitivity of the strains of organisms in the diseases for which it is being used has inevitably given the impression of diminished efficacy; it is more likely, however, that this has little or no relation to any established factors other than fashion and usage.

Spectrum. Penicillin is effective against Gram-positive bacilli including anaerobic organisms, Gram-positive cocci, the Gram-negative diplococci, the spirochaetes and actinomyces.

Administration. Intramuscular. Sometimes oral. Sometimes intrathecal.

Dose. Penicillin is given intramuscularly in doses of 100,000 units at six or eight hour intervals. This may be increased by giving multiples of 100,000 units, remembering that the increase must be from 100,000 units to 500,000 or one million or two million units. The time interval may be altered in fractions of six or eight hours. In acute bacterial infections where the patient is seriously ill, two million units second hourly may be the determined dose. Intravenous penicillin is not used very often as the effect is transient unless enormous doses are administered continuously. Subcutaneous injection with hyaluronidase is a very effective way of administering penicillin if doses of more than 30 million units per day are required.

Penicillin is prepared as a white crystalline powder known as crystalline penicillin G and

is dissolved in sterile distilled water or physiological saline.

Various other forms of penicillin have been developed in which absorption is slow after injection and the effect is prolonged over several days. This has been achieved by preparing the penicillin in oily solutions or in combination with a salt of procaine. These preparations are known as repository penicillins. Injections are given daily in amounts from 300,000 units to 1,000,000 units per injection.

Oral penicillin which is prepared in buffered tablets of the sodium or potassium salts is well absorbed but is only 10—30% efficient when compared with intramuscular injection. Oral penicillin is not therefore recommended as a means of treatment of severe infections due to organisms which show only low or moderate sensitivity. Oral penicillin is used to prevent recurrence of rheumatic fever in children.

The intermittent intramuscular injections of aqueous penicillin is to be preferred to the repository preparations in the treatment of deep and walled-off foci of infection. Repository forms may be useful for deep foci infection whenever the organisms are sufficiently sensitive and there is adequate access to tissue fluids, as may be the case in syphilitic or haemolytic streptococcal infections.

The use of probenecid "benemid" with penicillin raises the peak levels and sustains high concentrations between intermittent intramuscular injections.

In dental practice penicillin has many uses, and it may be fair to say that here the topical use of penicillin may be justified especially in the treatment of root canals where there is ready access and the organisms concerned are highly penicillin sensitive. Before the extraction of teeth in a person with valvular or congenital heart disease the use of penicillin intramuscularly as a prophylactic may be justified to minimise the risk of bacterial endocarditis. Repository forms of penicillin may be used.

Cellulitis following dental procedures will usually respond to penicillin as it is nearly always caused by penicillin sensitive organisms.

Actinomycosis is another hazard of dental extraction and it is well to remember that the organisms usually respond well to penicillin in sufficient dosage, e.g., at least 30 million units a day in divided doses.

Toxicity. Toxic reactions to penicillin are well known. They may come on some days or weeks after therapy has been stopped. Toxic reactions can be fatal.

STREPTOMYCIN.

Although streptomycin remains the major mainstay in the treatment of tuberculosis, two important features have led to renewed interest in this agent and an increase in its systemic use in many non-tuberculous infections. One is the use of small doses (1 or 2 g. a day) and shorter courses, which minimise the occurrence of the major toxic effects of this antibiotic on the eighth nerve; the other is the use of streptomycin in combination with other agents, particularly with large doses of penicillin, which has resulted in an increase in its effectiveness against relatively resistant Gram-positive organisms, coupled with a reduction in the rate and degree of emergence of streptomycin-resistant variants. The latter usage is best typified in the treatment of bacterial endocarditis due to organisms which are only slightly sensitive to either penicillin or streptomycin separately. It is important, however, to avoid the use of streptomycin alone in such cases, lest resistant variants emerge rapidly during such use and subsequently interfere with the successful application of the combined therapy.

Spectrum. Streptomycin is effective against Gram-negative bacilli, especially those of intestinal origin, the *Mycobacterium tuberculosis* and in some instances *Proteus vulgaris* and *Pseudomonas pyocyanea*.

Administration. Intramuscular. Topical sometimes.

Dose. 0.5 grams twice daily up to a maximum of 10-12 grams for infections other than those due to *Mycobacterium tuberculosis*.

In tuberculosis the dosage is 1 gram twice a week but the antibiotic should always be given in combination with P.A.S. or Isoniazid.

In tuberculous meningitis the dose is 2 grams per day intramuscularly for some months. Streptomycin is a white crystalline powder soluble in sterile distilled water or physiological saline.

Toxicity. In moderate doses toxicity is slight and usually there are no side effects. The toxic effects are vestibular dysfunction which comes on early, is recognized early with the symptoms of giddiness and which may be reversible if the treatment is stopped; and auditory-nerve damage leading to deafness which may be insidious and delayed in its onset and is usually irreversible. Dihydrostreptomycin is most likely to cause auditory nerve damage and its use should be avoided.

THE TETRACYCLINES.

Spectrum. The tetracyclines are effective against Gram-positive cocci including Strep-

tococcus faecalis, Gram-negative bacilli, Gram-positive bacilli including the anaerobic organisms, the spirochaetes, actinomyces, psittacosis, lymphogranuloma venereum, granuloma inguinale, tularaemia, *Entamoeba histolytica*, *Pseudomonas pyocyanea* and *Proteus vulgaris*.

Administration. Oral. Intravenous. Intramuscular.

Dose. Oral. 1 gram per day in four divided doses of 250 mgm. Intravenous. 1 gram per day in two divided doses of 500 mgm. Intramuscular. 400 mgm. per day in four divided doses of 100 mgm.

The tetracyclines are prepared as capsules or tablets of strengths ranging from 50 mgm. to 250 mgm. for oral use, as specially buffered crystalline powder for intravenous or intramuscular use.

Toxicity. Toxic reactions are not uncommon and may be very distressing. The commonest are nausea, vomiting and diarrhoea, with pruritus ani and in the female pruritus vulvae as well. The toxic reactions are seldom fatal but may cause prolonged disability.

The tetracycline antibiotics are still highly effective against infections due to a variety of Gram-positive and Gram-negative organisms and also against rickettsial infections. They appear to be the most effective agents available against the psittacosis-lymphogranuloma-trachoma group. There is no clear cut proof of the effectiveness of the tetracyclines in uncomplicated viral infections. Doubts have been raised as to the efficacy of aureomycin in the treatment of cases of primary atypical pneumonia.

There is abundant evidence of a decreasing efficacy of the tetracyclines in treatment of staphylococcal infections especially in hospital or in infections acquired during the course of treatment.

CHLOROMYCETIN. (CHLORAMPHENICOL)

Spectrum. Chloramphenicol is effective against Gram-negative bacilli of intestinal origin, *Haemophilus influenzae*, *Haemophilus pertussis*, *Brucellae* the *Salmonellae*, *Bacillus friedlanderii*, *Proteus vulgaris*, *Pseudomonas pyocyanea* and rickettsiae.

Administration. Oral. Intramuscular.

Doses. Oral. 1 gram per day in four divided doses of 250 mgm. (in special cases such as severe typhoid fever the dose may be increased to as much as 6 grams per day). Intramuscular. 0.5 grams twice daily.

Chloromycetin is prepared in capsules of 250 mgm. each or in solution for intramuscular injection.

Toxicity. The most severe toxic reaction which may be encountered is depression of bone marrow activity which may be fatal. It would seem from published data that while it is certain that blood dyscrasias may arise from the use of chloromycetin, the occurrence is not high considering the frequency with which chloromycetin is used.

It is true too that this antibiotic should not be used repeatedly for minor ailments, for prophylaxis or where any risk at all would be difficult to justify. It should be used without hesitation, however, in those diseases where it is very clearly indicated.

ERYTHROMYCIN.

This newest of antibiotics has a spectrum very close to that of penicillin. As this antibiotic has not been used on a large scale as yet, at least in Australia, the occurrence of erythromycin resistant strains of organisms, especially staphylococci, is not yet a problem; but as mentioned above, when discussing the dangers of antibiotics, resistant strains can occur and can develop resistance very rapidly. It would seem logical therefore to restrict the use of erythromycin to the treatment of infections due to organisms resistant to all other antibiotics and so preserve its usefulness for the greatest length of time.

CONCLUSION.

In concluding this review it is admitted that much has been omitted. It is hoped however that the problems of antibiotic therapy have been stressed and it is suggested that the following facts merit consideration.

1. Adequate bacteriological examination and adequate antibiotic sensitivity tests are essential whenever practicable.
2. Medical and dental practitioners should remember that there was a "pre-antibiotic" era in which patients did recover from infective processes without the use of antibiotics.
3. Antibiotics should not be used as universal anti-pyretics.
4. The prophylactic use of antibiotics should be approached with caution.
5. The dangers of antibiotics must never be forgotten.
6. Antibiotics do not replace aseptic technique.

Under this heading will be printed from time to time articles especially written for this Journal which are considered to be of broad general interest to the dental profession—Editor.

Some Clinical and Technical Aspects of Partial Dentures*

John H. Wilson, D.D.Sc. (Syd.)†

Annie Praed was of an older generation than my own, but I remember her giving to posterity a sense of service and professional standards of the finest quality.

Her lifelong interest was prosthetic dentistry. After more than thirty years of private practice, sustained with scholarship, she submitted to the University of Sydney a thesis entitled "The Problem of the Excessively Resorbed Alveolar Ridge." In the opinion of the examiners this was a contribution of distinguished merit, adding to the knowledge of the science of prosthetic dentistry. Accordingly, and much to the delight of her colleagues, the Senate of her University conferred upon Annie Praed the degree Doctor of Dental Science. She was then sixty-five years old.

Interested in the science of prosthetic dentistry, her rewards were those of the spirit. I am certain that whatever modest material success came her way was incidental to thinking of prosthetic dentistry in terms of knowledge. Annie Praed had a humility becoming those mature in mind. She knew no reward in life other than that due to merit. I am grateful to your Association, Mr. President, for inviting me to be associated with her memory. By request, this lecture will discuss briefly a few aspects of partial dentures in everyday practice.

Impressions.

The chemistry and physical properties of the colloid impression materials, reversible and irreversible, are now well known. Practitioners are also familiar with the preparation of these materials and their insertion into the mouth before gelation commences. During gelation two clinical factors are important, (a) a uniformity of bulk to the colloid (as far as practical), (b) stillness of the material. There are chemical and physical reasons for these objectives, suffice to say conditions are not fulfilled with a stock impression tray. When different thicknesses of the colloid material are related to resistant and non-resistant oral tissues and a movement occurs

during gelation, compressive stresses are sustained. Later these stresses are expressed as distortions and the casts are inaccurate. A uniformity of bulk to the colloid material can be achieved only by the construction of individual impression trays and the use of inserts or stops which keep the tray a prescribed distance from the teeth and soft tissues relevant to the case.

Individual Impression Trays.

These can be constructed as follows: on the first visit of the patient take a compound impression of the proposed area of restoration and pour the cast. Outline in pencil the extent of the final impression required. Eliminate any under-cuts and then add two thicknesses of modelling wax to the cast to cover the impression area. Seal the edges of the wax to the cast and then dust with chalk. Gently heat an aluminium impregnated shellac baseplate and adapt to the waxed cast the cool side of the baseplate. Cut away an excess of baseplate with scissors but leave enough margin to roll back to give a strong, rounded edge to the tray. Strengthen the baseplate with heated inserts of round galvanised wire where necessary. Add a handle of 16 gauge round wire by heating and embedding the ends in the baseplate. Smooth such insertions with a hot wax knife. Use a No. 8 rosehead bur to make perforations for the retention of the colloid material. Add small compound stops, usually three, about $\frac{1}{8}$ inch high, at selected sites so that the tray will be a fixed distance from teeth and soft tissues. Finally, if it is an upper impression tray, add a strip of wax across the heel of the tray to control a palatal flow of the impression material (Fig. 1).

Wipe the impression material into the retention holes in the tray before placing the main bulk of the colloid. With the index finger, carry a small amount of colloid into occlusal rest preparations prior to inserting the tray. When the tray has been wriggled into position and the contact of the stops with teeth or tissue is felt, keep the tray and its contents perfectly still for four minutes and then remove the impression abruptly.

If this type of individual tray is used for the reversible colloidal materials, the operator will have to depend upon a water syringe for

*The Annie Praed Memorial Lecture for 1954, delivered at a meeting of the Australian Dental Association (N.S.W. Branch) on 22nd June, 1954.

†Lecturer in partial denture construction for the Post-Graduate Committee in Dental Science, the University of Sydney.

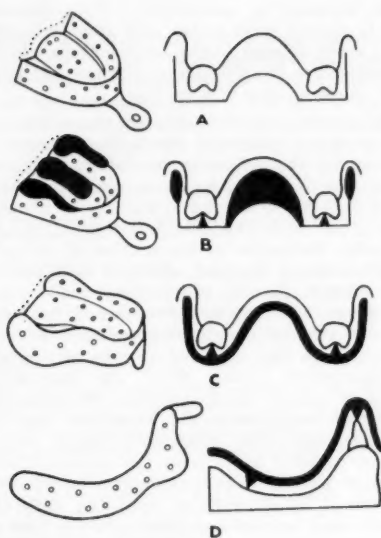


Fig. 1. Impression trays

- A. Stock tray. Gives variable bulk to the impression material; the method is clumsy and inaccurate.
- B. Stock tray modified by building up in compound. Gives reasonable control over the bulk of material. "Stops" are shown as needed to keep the tray a fixed distance from the tissues. Waxing of the heel of the tray to prevent flow of material over the soft palate is also necessary. Compound surfaces should be serrated and cleaned with methylated spirit for good union with the impression material.
- C. Shellac baseplate tray made as described in the text. It gives uniform depth to the impression material. Suitably placed "stops" maintain the stability of the tray and prevent impression being taken under pressure. Wax is used across the post-dam area.
- D. Similarly fashioned tray for lower case. A large drop from the incisor teeth to the ridge makes use of a stock tray impossible. Individual trays are efficient, time saving and comfortable to the patient.

homogeneous cooling. As the material will be relatively thin even the disadvantage of syringe cooling will be considerably less than when stock trays are built up with a mass of impression compound. Immediate pouring of the casts before the release of induced stresses is advisable despite all precautions taken to prevent a stressed impression.

Recording of Centric Occlusion.

The centric occlusion to be recorded for the everyday clinical case is the habitual centric occlusion given by the patient, i.e. maximum tooth contact with a retruded, but not a strained, position of the mandibular condyles in the glenoid fossae with the jaws related as correctly as possible in the median plane. A decision to increase the vertical dimension of the face "opening of the bite"—does not depend on mechanical features alone. It can

be attempted only after a competent occlusion analysis involving a prescribed clinical and radiographic examination of the biological and physiological factors. There should be sound factual reasons for "opening the bite" and techniques must be reconciled to the reaction of living tissue to any alteration of masticatory stress. Reconstruction of the occlusion to a high functional level is a scientific subject. The technical phase, however brilliant, is secondary to a diagnosis. In a collective sense partial dentures can make a limited technical contribution. To what extent depends upon the nature of the traumatic problem to be treated. Without decreasing the vertical dimension of an habitual centric occlusion, malocclusion of the teeth should be rectified as much as possible by a selective grinding as a part of a preparatory treatment.

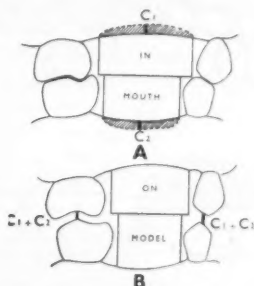


Fig. 2. Registration of habitual centric occlusion.

- A. When the registration is taken in impression compound or modelling wax the tissue displacements could be C_1 and C_2 .
- B. Occlusion rims placed upon the stone casts. There cannot be a displacement of the stone casts so centric occlusion will have an error equal to the sum of C_1 and C_2 .

When casts of the mouth have been prepared many habitual centric occlusion relationships will be obvious. If the relationship of the casts is uncertain, occlusion rims must be constructed. Such rims must be stable firstly on the casts and secondly in the mouth. The widest possible use of occlusal rests and the registration of centric occlusion without pressure upon the material of the occlusion rim is therefore indicated. Errors of occlusal registration, due to tissue displacement, are shown in Fig. 2. Such errors may not be obvious clinically. When they are added to occlusal alterations due to the processing of the denture the final correction may have to be considerable. Both the impression and the occlusion registration should be taken without tissue displacement. When the denture has been processed the problem of the so called "functional displacement" of the soft tissues sites is attended to, if not solved, by relining the denture base.

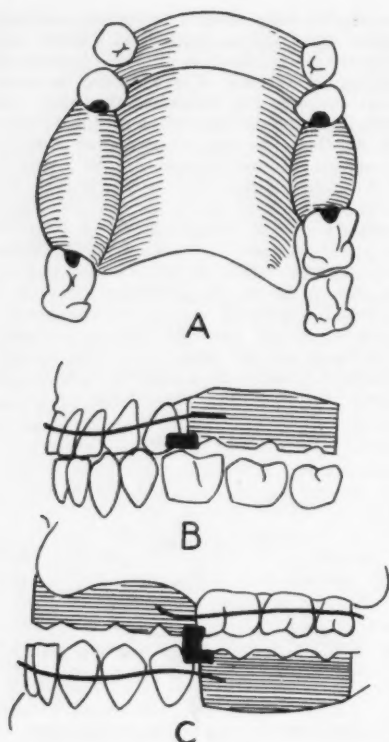


Fig. 3. Occlusion rims.

- A. Full use of occlusal rests and close fitting base.
- B. Occlusion rim of Class II saddle with impression compound reduced by $\frac{1}{4}$ inch. It is serrated to hold a plaster mix for the registration of the lower teeth. A strong labial wire gives stability to the rim.
- C. Rims for the Class D relationship prepared in compound and reduced for plaster wash. The compound insert between molar and premolar maintains the vertical dimension decided upon. Labial wires stabilise the occlusion rims. When there is little overjet and much overbite the labial wire may have to be placed below the gingival margins.

Occlusion Rims.

For all cases without a distal extension saddle (Class II), i.e. for all tooth-supported saddles, occlusion rims can be made in hard modelling wax reinforced with wire mesh, baseplate or wire inserts. The occlusal rests, used in all places where they will appear in the finished denture, are made from short lengths of 20 gauge galvanised wire, flattened for the rest preparation (Fig. 3a). They must be attached securely to the base of the occlusion rim. Registration of the cusps of the opposing teeth is recorded in softened wax. If the visual examination for

tooth contact is satisfactory, the occlusion rim is chilled with water and removed. The casts when related to the occlusion rim should correspond to the position of the natural teeth with the occlusion rim in place.

Stabilisation of the occlusion rim when one or two distal extension saddles are present is secured by the following procedure (Fig. 4). Cover the distal extension saddle with tinfoil 0.003 inch thick leaving a margin of about $\frac{1}{4}$ inch in excess of the saddle dimension. Adapt a shellac baseplate to the outline of the proposed occlusion rim and reinforce it with wire. Mix a zinc oxide and eugenol impression paste and apply it to the undersurface of the baseplate of the distal extension saddle. Seat the baseplate on the cast and remove any excess of impression paste. When the impression paste is almost hard, burnish the marginal excess of tinfoil over the baseplate: the foil together with the impression paste should give a rounded margin to the occlusion rim. Contour sufficient 16 gauge galvanised wire to form a labial retainer, heat the ends and embed them in the baseplate. Add a wax or compound rim to the baseplate but keep it about $\frac{1}{4}$ inch short of occlusal contacts. Make the surface retentive for a plaster wash which will record the cusps of the opposing teeth without pressure. Tooth supported saddles if present in the occlusion rim must have occlusal rests.

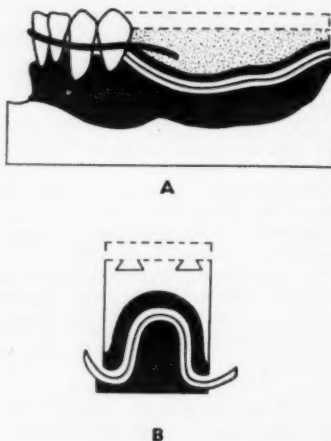


Fig. 4. Occlusion rims for soft tissue supported saddles.

- A. Stabilisation of the occlusion rim with a 16 gauge labial galvanised wire. The wire may have to be placed away from tooth contact so as not to interfere with the opposing teeth.
- B. Parts of the occlusion rim from the cast are: tinfoil 0.003 inch thick, zinc oxide impression paste, baseplate, compound to within $\frac{1}{4}$ inch of occlusal contact, plaster of Paris with retention in the compound.

Design.

This must only follow a thorough examination of the mouth, a diagnosis and then a preparatory treatment of the mouth, perhaps involving several aspects of dentistry, particularly periodontia and orthodontics. One can recall with much profit a statement by Box:

The rapid march of scientific dentistry will depend in large part on the development of periodontal physiology and its application by discerning pathologists and practitioners to their respective fields.

A partial denture, designed upon a stone cast without reference to an oral examination and diagnosis is not dentistry, but a major form of dental malpractice.

Others have written upon this issue:

The replacement of missing members of the human dentition with artificial substitutes is not a simple mechanical problem; it is a decidedly complicated one, calling for a thorough appreciation of biologic facts that rigidly circumscribe and limit mechanical procedures. (Tench)

Materials and methods avail but little when the structural characteristics of the tissues are ignored—the biologic factors are the directory influence or controls that determine the virtue of the procedure employed in clinical practice. (Pendleton)

Treatment of any given organ must follow a diagnosis which depends upon a thorough knowledge of the function of the organ. (McCallum)

A high grade oral health service transcends the actual making of a substitute for the missing teeth. (Wright)

These opinions then point the general direction of partial denture design. After them the dentist passes to these important particulars:

- I. All partial dentures are *one* or a *series* of monotype saddles, each with its physiological value, diagnosis and classification. Design for each saddle area must be within the range of physiological tolerance for that particular saddle.
- II. All parts of a partial denture are of equal importance, yet there should be a surveyed or overall design establishing the case as a composite unit. This, too must be physiologically acceptable in a collective sense.
- III. Simplicity of design is desirable. This is in the interests of preventive dentistry and it makes a good denture economically available for many people.

Amongst the many requirements of a good partial denture are the following:

- I. It must not cause ill-health of the hard or soft tissues.
- II. Functional stresses induced by the denture should be similar to those made by the forces of mastication for that particular mouth.

- III. When the mouth is at rest the denture must have passivity. In mastication the denture should relieve hyperfunction of the natural teeth and increase, without discomfort, the collective functional efficiency.
- IV. A calculated relation with the tissues either when at rest or in function should be maintained.
- V. The denture should satisfy standards of aesthetics and phonetics and economy of tooth structure.

Neurohr, Schuyler and senior prosthetists are in agreement with the above specifications.

There are certain steps in a design leading to the complete denture (Fig. 5). In order of preference the design is evolved from:

- I. a classification of saddle areas and the placing of occlusal rests,
- II. outline of the saddles,
- III. determination of the saddle connectors,
- IV. selection of the retention units,
- V. indirect retention,
- VI. stress breaking,
- VII. occlusal loading; selection and placement of artificial teeth,
- VIII. aesthetics and
- IX. relining, particularly the distal extension of Class II saddle.

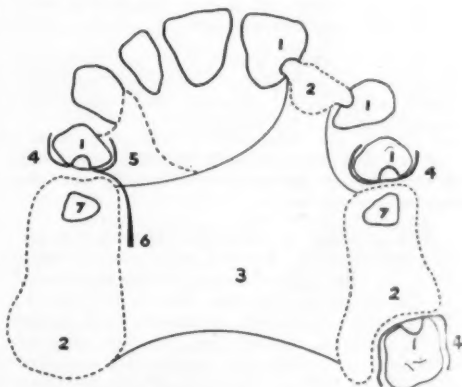


Fig. 5. Technical steps in the design of a partial denture.

1. Positions for occlusal rests.
2. Saddle areas.
3. Saddle connectors.
4. Retainers.
5. Indirect retention.
6. Stress-breaking.
7. Selection of artificial teeth, saddle loading and arrangement in relation to ridge.

An adopted sequence in the technical planning of a denture makes for orderliness of procedure. The above is evolved from saddle classifications and their treatment.

The importance of the latter phases of a partial denture is not diminished because of their position in the sequence of development. The principles of design are similar for skeletal and non-skeletal dentures (Fig. 6).

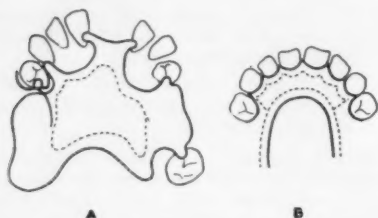


Fig. 6. Skeletal and non-skeletal designs.

The principles of partial denture construction are exactly the same whether the denture be in metal or acrylic. The biological and physiological considerations are a constant which can be well respected without relation to economics.

In figs. A and B the heavy outside lines indicate the design of acrylic dentures. Within the dotted lines is the material that is removed if a more elaborate skeletal denture is constructed in metal.

Classification of Saddle Areas and the Use of Occlusal Rests.

The writer uses the following classification of saddles:

Class I. those which are completely tooth supported and whose prognosis is good.

Class II. those which have an abutment tooth at one end of the saddle only and both tooth and tissue (mucosa and supporting bone) are used for support.

Class IIB. the saddle is entirely tissue supported e.g. a lower jaw with only the two canines remaining.

The prognosis for the Class II case is generally satisfactory. Factors with most influence here are the type of bone (dense, cancellated or non-cortical) and the muscle function of the patient. Technical treatment such as the gross occlusal overloading of the support, traumatic retention and inadequate stabilisation of the denture naturally affects adversely the prognosis.

Class III. saddles are tooth supported. They differ from the Class I saddle in their prognosis, which is relatively poor because the diagnostic data is comparatively less favourable. Common to the Class III saddle are long spans and abutment teeth with bone support less in quantity and quality than the Class I saddle. Often the Class III saddle has a heavy opposing occlusion. In general the prognosis cannot be very favourable. Sometimes, as suggested

by Beckett, it may be a better procedure to extract a doubtful distal abutment tooth and convert the Class III into a Class II saddle.

Use of occlusal rests is in accord with the classification of the saddle areas. They relate the diagnosis to the support. Some features of occlusal rests are as follows:

- I. They must not interfere with occlusal relationships and should be properly seated in preparations.
- II. They should transfer as far as possible the stress of mastication to the abutment tooth in an axial direction and they should be sufficiently robust to do so for many years of service.
- III. When used on inclined teeth in Class I and Class III saddles they should be seated more deeply with a decided vertical dimension to avoid a tipping effect upon the abutment teeth under vertical loading. If it is impossible to provide against such orthodontic forces with a proper occlusal rest preparation, the torques must be controlled elsewhere in the denture design.
- IV. The interproximal part of the occlusal rest must not extend beyond the survey line which, in effect, is the contact point for a particular inclination of the cast. Any extension gingivally to the survey line will produce movement of the supporting tooth.
- V. The occlusal rest preparation should be economical of tooth structure.

The detailed requirements of occlusal rests in relation to teeth with and without restorations cannot be set out in a general paper such as this. It can be claimed without serious challenge that many partial dentures fail both clinically and technically because of the misuse of occlusal rests in relation to the support available, particularly when related to tipped teeth.

Outline of Saddles.

In tooth supported saddles, i.e. Class I and Class III the extent of the saddle outline is of no significance in relation to the forces of mastication. It is of no avail with a tooth supported saddle to seek tissue support as an aid because the saddles cannot be depressed beyond the fixation given by the occlusal rest. In the Classes IIA and IIB saddles, i.e., the distal extension saddles, the support given by the tissues (mucosa and bone) is all important. It is important not only in terms of the available area but more so in terms of the type of bone structure, degree and type of resorption,

distribution of mucosa and the opposing occlusion as disclosed in the mouth examination. The physiology of bone, particularly in response to pressure, will forever claim precedence over the technical aspects of dental prosthesis.

The Class II saddle outline should be as large as possible, the aim being to obtain a low force of mastication per unit area. However, an attempt to distribute functional stresses over as large an area as possible is determined by anatomical factors. Over extension of the saddle base conflicts with functional comfort and the saddle has to be reduced until irritation of the tissues is removed. Seldom can the prosthetist extend the saddle outline beyond the mylohyoid ridge or over thinly covered tuberosities. Inflammatory reactions in the mucosa will be less frequent when the saddle outline is determined by the general survey of the cast for the placing of retainers. In many instances there is the tendency to limit a survey for the path of insertion and removal of the denture only to the teeth involved in providing retention. It is equally important to survey the epithelial contours.

Saddle Connectors.

All saddle connectors must be rigid. If they are flexible the stresses of mastication are transmitted through the denture obliquely and adversely to the support, instead of the denture itself withstanding the stress. Saddle connectors are in the form of palatal bars (metal or acrylic) lingual bars (metal or acrylic) and lastly labial bars (usually metal). The many known specifications and forms of saddle connectors are correlated with the anatomical contours and spans of each case to be treated.

Retainers.

Whether made in cast or wrought metal all retainers must be related to a survey line which fixes the denture as a single unit for the purposes of insertion and removal. The position of the survey line determines the design of the retainer. The selection of a cast or wrought wire retainer is controlled by the prosthetist. Retention is only concerned with preventing dislodgment of the denture by adhesive foodstuffs and, in the case of a partial upper denture, the very minor influence of gravity. Most parts in a retainer contribute to the stabilisation of the denture i.e. support and resistance or bracing to oblique displacement. Only the terminal end of one part of the retainer has the function of resisting an

occlusal displacement of the denture. All other parts of the retainer are kept above the survey line.

In general, all retainers must conform to the principles stated by Roach i.e. they must possess retention, fixation, reciprocation and stabilisation. Additional qualifications are aesthetics, small tooth contact and simplicity of construction.

Retention of the partial denture should be distributed over two or more teeth, preferably related diagonally. The vertical dislodging force during mastication is at right angles to the occlusal plane but this does not mean the cast should be surveyed in the horizontal position. A path of denture insertion or removal, slightly off the vertical is indicated. Another factor opposing a horizontal survey of the cast is that a survey at right angles to the occlusal plane may give an optimum horizontal position of the survey line for only one particular tooth. As the retention should be allocated to two or more teeth it is the sum of the optimum retention areas available which is of the greatest value. A horizontal survey of the cast would be indicated if all the abutment teeth were bell shaped and their crowns vertical. Such an ideal, but unlikely, situation would dispense with the greatest need for surveying the cast.

The extent to which the retaining element should go beyond the survey line depends upon the degree and extent of the cervical convergence of the tooth. Others factors are the physical properties of the metal, cast or wrought, the cross sectional dimension of the metal, its proportional limit and flexile properties. Undercut gauges and the use of pre-fabricated patterns are not satisfactory in practice. It is difficult to find the tooth to fit the pattern. To a great extent the use of retentive areas may never advance beyond the judgment and experience of individual prosthetists. Excessive retention serves no purpose and if it is not traumatic it is so potentially. Additionally it involves undesirable work hardening of the alloy used. Any attempt to dispense with direct retainers has to be reconciled to physiological principles. The principles involved are those of the basic sciences upon which prosthetic dentistry claims a professional status. However commendable it may be to omit retainers on teeth to prevent dental caries it is obvious they contribute much more than retention to the denture design. Those who prefer to think of retainers as precision devices related to living tissues do not consider they are destructive. Some forms of the cast retainer and the assembly of the stainless steel wire retainer are shown in Figs. 7, 8 and 9.

Indirect Retention.

This opposes the occlusal rotation of the denture through any axis across the occlusal rests of the direct retainer. Operating in a position remote from the direct retention it reduces the functional demands made upon the direct retainer. Three ways of providing the denture design with indirect retention are by extension of the denture base across the fulcrum line passing beneath the occlusal rest or rests of the direct retainers, the use of Cummer extension arms or by means of the continuous clasp. Though primarily intended to oppose occlusal movement of the denture, indirect retention also helps to stabilise the denture against oblique forces.



Fig. 7. Some cast retainers suggested by Ney for various tooth inclines.

- A. Basic positions of the survey line, with a constant position for the occlusal rest. Retainer design for the first two survey lines is correct, but wrong for the third. The retainer design shown in D would be acceptable.
- B. Marked lingual inclination of the crown of the tooth indicates lingual retention and buccal reciprocation and stabilisation.
- C. When there is a buccal inclination retention is used on the buccal, other elements in the retention unit are placed lingually.
- D. With a vertical position of the tooth crown various types of retainers are possible.

In B., C. and D, the horizontal lines show the position of the survey line bucco-lingually.

Stress-Breaking.

This is indicated when a movable part of the denture, i.e., a class II saddle is connected to a fixed part, such as its retainer or to tooth-supported saddles elsewhere in the restoration. Sometimes stress-breaking is used when it is necessary to place a retainer upon a tooth with poor bone support. Basically the problem is to achieve equilibrium of movement between the functional displacement of the periodontal membrane, the mucosa and the stress-breaker. The need for stress-breaking diminishes in direct ratio to the overall stability of the restoration and there are many factors which determine this property. Attempts to achieve a properly stress-broken denture have been responsible for great variations in design for similar cases. Quite probably specific stress-breaking has been overstated to the neglect of equally important aspects of design. Practitioners have investigated the following.

- I. The use of a flexible wire joining the retainer to the displaceable saddle.

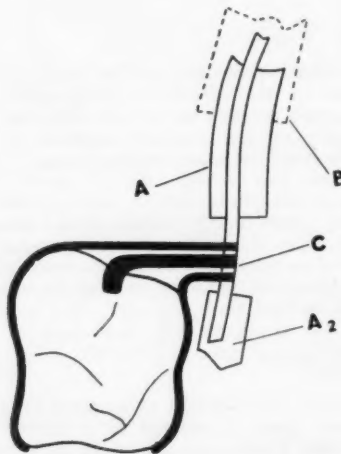


Fig. 8. Tacking stainless steel wire retainer to strengthener (after Hooton).

A and A2 represent tinfoil 0.003 inch thick. This keeps the reinforcing wire C away from the cast during the assembly of the retainer wires. Before processing the denture this foil is replaced with foil 0.001 inch thick. Acrylic can then cover the reinforcing wire and retainer ends. Labial and lingual retainer wire together with the occlusal rest wire meet at C. Here they are "tacked" together with tin solder. The flux is phosphoric acid. Tinfoil supports must not become involved with the tin solder.

- B. Leadfoil relief to gingival margins.

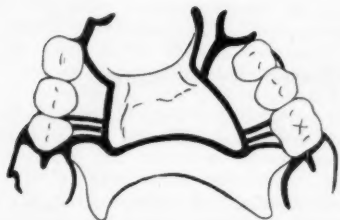


Fig. 9. An acrylic denture with cast and stainless steel wire retainers "tacked" to a reinforcing half round stainless steel wire. Laboratory investigations show that metal inserts "weaken" the physical properties of acrylic. However, in the author's opinion they give clinical rigidity to the saddle connectors and reduce functional fatigue in the material. Should a fracture occur the parts are at least related until a repair can be made. The stainless steel wires generally used have the following specifications: Round 0.8 and 0.9 millimetres. Half round 0.75 x 1.25, 0.87 x 1.75 and sometimes 1.0 x 2.0 millimetres.

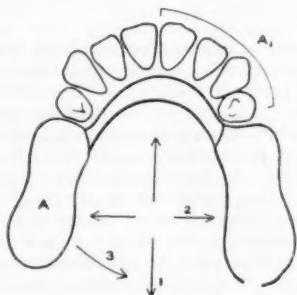


Fig. 10. Stabilisation of a partial denture.

Movements:

1. Antero-posteriorly. This is controlled by direct retention, inclination of the supporting ridges, inclination of the occlusal plane and balanced occlusion, if possible.
2. Horizontal. Controlled by direct retention, continuous bar depth of ridge, balanced occlusion.
3. Rotation or twisting movements. Control is similar to that for a pure side to side movement. An anti-clockwise displacement of saddle A is resisted by section A1 of the continuous bar, the lingual depth of the right saddle, the lingual aspects of the right direct retainer, the buccal depth of the left saddle A and the buccal element of the left direct retainer.

It will be seen how essential it is to have rigidity of the saddle connectors in order to lessen saddle rotation and prevent fatigue and perhaps fracture of other units of the denture.

Occlusal disharmony can be a factor in all forms of denture instability.

Vertical stabilisation is required for both (a) occlusally and (b) gingivally directed forces.

Occlusal displacement is resisted by direct and indirect retention. Gingival displacement is controlled by the proper use of the available support, teeth and soft tissue. The functional value of the partial denture is proportional to its correct stabilisation. The relation between denture stability and health of the living tissues is equally important.

Illustrations from "Partial Dentures" by John H. Wilson in course of publication—Angus & Robertson, Sydney, London.

II. Various ways of using the split saddle connector with the retainer connector giving a dispersion of functional stress through the denture.

III. Distal retention on the abutment tooth.

IV. The precision attachment with an adjustable extension unit included in the first tooth on the saddle.

To the writer it would seem that forms of purposeful stress-breaking can be defeated by such factors as bad occlusal relationships, incomplete stabilisation of the restoration and in particular the failure to control, by relining, the movement in Class II saddles. Forms of stress-breaking have been criticised adversely when, in reality, their failure has been due to assuming functions which should have been carried out by other parts of the restoration. Stress-breakers must only be used in the presence of the maximum degree of denture stability attainable (Fig. 10).

Occlusal Loading.

This is a matter of adjusting the forces of mastication in both magnitude and direction to the support available. The laws of occlusion are accepted as the key to many problems in full denture prosthesis. More so, must occlusion be a dominant factor in a partial prosthesis. Partial dentures attached to supporting teeth can be instruments of destruction when occlusal relationships are not considered. Mainly through the proper occlusal loading of the support, can partial dentures have that quality of relieving hyperfunction of the remaining natural teeth and increasing without trauma or discomfort the collective functional efficiency of the mouth. No doubt malocclusion has been responsible for more damage to the mouth than dental caries. It is bad enough to relate a partial denture to a natural malocclusion that cannot be greatly helped, but to add to the occlusal chaos by arranging teeth on a denture without reference to the environment is not prosthetic dentistry. For many reasons the natural dentition will not have a balanced occlusion. Nevertheless, the general occlusal pattern, if indicated by the remaining teeth, should be followed. Unwise is he who overloads the available support and neglects such matters as the plasticity of bone and the dictates of physiological tolerance. The use of teeth which are narrow bucco-lingually, a reduction in the number of teeth upon a saddle, and the proper placing of the teeth, control the demands made upon the support.

Adamantinoma in Relation to Tooth Development*

E. B. Manley, M.Sc., B.D.S. (Birm.), F.D.S.R.C.S. (Eng.)†

From a study of the more recent literature it is clear that considerable confusion still exists concerning the identification of the epithelial tumour of the jaws known as adamantinoma. The uncertainty surrounding the histology and pathogenesis of this tumour is reflected in the nomenclature. In the course of time almost a score of names have been given to it. It is generally agreed that the term adamantinoma is inappropriate but as it is the one in general use it will be adhered to throughout this communication.

Histological identification of the nature of a tumour depends on a recognition of the type of cells of which it is composed. In a slowly growing tumour the cells are usually well differentiated and difficulty of recognition does not often arise. Adamantinoma is a slowly growing tumour whose cells have actually attained a marked degree of differentiation and yet there are considerable differences of opinion concerning the precise identification of these cells. With few exceptions there appears to be general agreement that an adamantinoma arises from that epithelium which is especially concerned with tooth development. While no doubt this is true, the conclusion has been based for the most part on certain histological features of the tumour tissue which, it is claimed, correspond with those of a normal enamel organ. The main feature referred to is the stellate reticulum. This evidence, however, is insufficient and is a misleading factor responsible for much of the confusion. If such a comparison be studied carefully it will be found to be merely superficial and evident only under the low power of the microscope. It is pointed out quite correctly that the epithelial cells concerned with tooth development arise from the basal cells of the oral epithelium. From a similar cell of origin the basal cell carcinoma develops. When this is of the cystic type where the central cells break down and form many intercellular spaces, a resemblance to the stellate reticulum of the enamel organ is claimed. As a result, these two tumours, the basal cell carcinoma and adamantinoma are frequently

grouped together. Schulenburg¹ claims that adamantinoma bears many similarities to basal cell carcinoma and that it might even be more correct to name them both "basal cell carcinomas of the jaws." This is unfortunate for apart from histological evidence the clinical behaviour and treatment of these two tumours is quite different. The cells of an adamantinoma for example are the more highly differentiated and therefore could not be expected to respond to X-ray therapy as readily as a less differentiated basal cell carcinoma.

The so-called adamantinoma of the tibia has been diagnosed solely on the gross appearance produced by the breakdown of the central cells when it is then supposed to resemble the stellate reticulum of an enamel organ. It is unfortunate that adamantinoma should be confused with other apparently similar epithelial tumours found elsewhere in the body which by virtue of their location cannot arise from dental epithelium. As Willis² points out, occasional resemblance is not identity and he regards the so-called adamantinoma of the tibia as bone-invading epidermoid carcinoma and mentions that even a squamous cell carcinoma of the skin may occasionally resemble an adamantinoma.

The literature shows that sufficient attention has not been paid to the histology of tooth development and particularly to the precise part which epithelium plays in the process. It seems, therefore, that a clear presentation of certain stages of tooth development may help to remove certain misconceptions and thereby lessen to some extent the confusion that exists concerning the nature of this tumour.

I believe that there is a tumour of the jaws of dental origin, the distinctive characteristics and clinical behaviour of which are sufficiently defined to place it in a class by itself and that it arises from certain residues of that specialised epithelium directly concerned with tooth development and appropriately termed "dental epithelium" by Warwick James and Wellings³. It is to this type of tumour that the generally accepted but inadequate term of adamantinoma is applied and it may be regarded as one of the less common tumours of the jaws.

*Read at the 13th Australian Dental Congress, Brisbane, 1963.

†Professor of Dental Pathology, University of Birmingham.

Willis¹ describes adamantinoma as arising from "tooth germ residues." These epithelial residues need to be investigated and more clearly defined. On biological grounds it would be reasonable to suppose that stimulated residues of cells which have completed or nearly completed their function will behave differently from cell residues which have remained in a more embryonic stage. At one end of the story of tooth development we have the so-called "epithelial rests" of the periodontal membrane, cells which, as far as we know, have completed their function. At the other end we have to consider the possibility of residues of the dental lamina which breaks up and consists of highly potential cells about whose fate little if anything is known. The epithelial rests of the periodontal membrane if stimulated to proliferation, by infection for example, produce a stratified squamous type of epithelium commonly seen in dental granulomas and which forms the epithelial lining to dental cysts, and in no way resembles the epithelium of an adamantinoma. Proliferation of dental lamina cells presents a different picture—one in which the peripheral cells closely resemble the columnar cells seen in an adamantinoma. A close study of tooth development with particular attention to cytological detail reveals certain points which I feel are sufficiently suggestive to warrant support for the hypothesis that this tumour arises from residues of the dental lamina. Two pathological specimens sent to me for histological examination contained evidence of sufficient interest to warrant their presentation. The significance of these two cases can be understood more fully following a description of certain stages of tooth development.

The most important feature in tooth development is the influence of certain cells of the basal layer of the oral epithelium which begin to proliferate at a more rapid rate than the adjacent cells. They form an epithelial thickening known as the dental lamina, which runs continuously round the future dental arch of the jaws. At this very early stage these cells are seen to have acquired a degree of specialisation which differentiates them structurally from the surrounding basal cells of the oral epithelium. It is at ten points on the dental lamina corresponding to the future position of the ten deciduous teeth that these cells first manifest their ability to advance through the subsequent stages of tooth development. This dental epithelium has been defined by Warwick James and Wellings as "the special epithelium concerned with the development, eruption and fixation of the teeth." They ascribe to it two chief functions—one, the formation of the teeth and the other the determination and maintenance of their posi-

tion. It is the former function with which we are immediately concerned.

Figs. 1, 2 and 3 illustrate the stages of development of a human tooth germ from an early phase to a stage immediately prior to the formation of dentine and enamel matrix. In Fig. 1 the cells of the dental epithelium are seen to be longer and more clearly defined than the basal cells of the surface epithelium. At the base of the ingrowth they have assumed a columnar form and are already exerting an influence on the mesodermal tissue where a condensation of cells is evident—the primordium of the dentine papilla.

Fig. 2 represents a later stage where owing to unequal rates of growth the enamel organ has assumed the appearance known as the "cap" stage. The cells lining the concavity of the cap have differentiated further and assumed a definite columnar form. They are arranged in a continuous layer which constitutes the inner or internal dental epithelium with which we are chiefly concerned. The more cuboidal cells which form the convex surface of the cap constitute the outer or external dental epithelium and are continuous both with the cells of the internal dental epithelium in the form of a loop and with the basal cells on the surface. It is important at this stage to draw attention to the origin of the cells in between these two layers which will ultimately become the stellate reticulum and stratum intermedium of the enamel organ. They are derived from the surface prickle cells of the oral epithelium with which they are continuous, either directly (Fig. 2) or later through the intermediary cells of the dental lamina (Fig. 3).

Fig. 3 represents an extremely important stage of development, the fully differentiated enamel organ known as the so-called bell stage, which consists of the four classical layers of cells. Two points should be stressed at this stage. The cells of the internal dental epithelium have assumed a clearly defined columnar form with a large centrally placed nucleus and have reached a degree of differentiation which represents a critical stage in their functional cycle. They now exert in their primary function of initiating the formation of dentine matrix by their organising influence on the cells of the mesodermal dentine papilla to form odontoblasts. It is only after this primary function is fulfilled and the first dentine matrix laid down that they further differentiate and assume the appearance of the highly specialised cells, the ameloblasts, or true enamel secreting cells. This is illustrated in Figs. 4, 5 and 6 where the cytological difference between the internal dental epithelial

cells and ameloblasts from the same tooth germ is clearly shown. Whereas it is known that no dentine can be formed in the absence of the dental epithelium⁵ it is equally true to say that no ameloblasts can be formed without the prior production of dentine matrix. The formation of dentine and enamel are interdependent but the dentine matrix is the first to be laid down and is always ahead of enamel.

The columnar cells which form the layer of internal dental epithelium in a fully differentiated enamel organ are almost invariably described in the literature as ameloblasts. This is a misconception for the differentiation of an ameloblast does not occur until *after* dentine matrix is laid down. It is, therefore, of some significance that no dentine is ever present in an adamantinoma, where consequently there can be no ameloblasts. The term ameloblastoma which is sometimes given to this tumour is, therefore, a complete misnomer. The peripheral basal cells of an adamantinoma histologically show a degree of differentiation comparable only with that of the superficial columnar cells of the dental lamina or the internal dental epithelial cells of the enamel organ. Lucas and Thackray⁶ regard the solid type of tumour as closely resembling the developing tooth up to the point at which differentiation of adjacent connective tissue cells into odontoblasts takes place.

A further feature of the fully differentiated enamel organ which has claimed much attention in view of a possible relationship to adamantinoma is the stellate reticulum, so named from the morphology of its cells. The typical stellate or star-shaped appearance of these cells, with their long processes which anastomose with similar processes of neighbouring cells, is produced by an increase in tissue fluid in the intercellular substance. It is important to note that the fluid separates the cells without breaking their intercellular connections and affords physiological support and protection to the cells of the internal dental epithelium until the matrix of the hard tissues is established (Fig. 7). It is a transient structure rapidly disappearing as soon as dentine and enamel matrix is laid down. The resemblance claimed between the stellate reticulum of a fully differentiated enamel organ and the central cells of the alveoli of an adamantinoma, which have been referred to previously, will not bear close investigation. The early microscopic cyst-like spaces seen in the central tumour cells are formed by degeneration and breakdown and can hold no relationship to the physiological stellate reticulum (Fig. 8). Furthermore in a recent study of tooth development, both human and comparative, Marsland⁷ has shown that under normal

conditions the stellate reticulum is always associated with the stratum intermedium, the fourth layer of the fully differentiated enamel organ. This layer of cells is found between the internal dental epithelium and the stellate reticulum and at the appropriate time is intimately concerned with the development of enamel. In the adamantinoma there is no such layer of cells which could resemble the stratum intermedium. This finding emphasises further the fundamental difference between the physiological stellate reticulum and the pathological area of cell breakdown in adamantinoma.

THE EPITHELIAL RESIDUES.

(a) *The Dental Lamina and Enamel Organ.*

Shortly after the enamel organ of the deciduous germ becomes fully differentiated, the dental lamina breaks up and the tooth germ loses its continuity with the surface epithelium. Isolated groups of highly potential epithelial cells remain in the area between the enamel organ and the oral epithelium (Fig. 9). The deeper portion of the lamina continues to proliferate on the lingual side of the deciduous germ and gives rise to the enamel organ of its permanent successor (Fig. 3). Posterior to the second deciduous molar a distal extension of the lamina gives rise to the germs of the permanent molars. Disintegration of both these laminar extensions occurs at a later stage, leaving behind, deeper within the jaws, residues of embryonic cells about which little is known. On the other hand our understanding of the fate of those epithelial cells which compose the enamel organ is more complete and has been the subject of a recent investigation⁸. The early disappearance of the stellate reticulum has already been referred to. The remaining cells of the enamel organ, when the enamel is fully formed and calcified, revert to the less differentiated squamous type of epithelium from which they originally arose. The layer of stratified squamous epithelium over the enamel of the unerupted tooth, with which it is organically united through the primary enamel cuticle, is known as reduced enamel epithelium. As eruption takes place, this reduced enamel epithelium fuses with the oral epithelium and as the crown of the tooth emerges into the oral cavity the reduced enamel epithelium becomes the sub-gingival epithelium, which forms the so-called epithelial attachment of the gingival tissues to the surface of the tooth. Every stage in this process has been studied histologically and it is apparent that under normal conditions no remnants of the enamel organ itself are left deep within the jaws.

(b) *The Epithelial Rests of Malassez.*

The junction of the internal and external dental epithelium of the enamel organ is known as the basal or marginal fold and forms a unit of considerable importance (Fig. 10). As development proceeds and the formation of enamel approaches its point of termination at the future cemento-enamel junction the internal and external dental epithelium at the basal fold approximate with the gradual elimination of the cells in between (Fig. 11). The external and internal dental epithelial cells continue to proliferate below the limit of enamel formation and constitute Hertwig's epithelial root sheath which initiates and controls the formation of root dentine. It is important to realise that the initiation of the dentine of the root in no way differs from that of the crown, the entire process being continuous. This continued proliferation of the external and internal dental epithelium presents a double layer of cells which, on section, appears as a loop. The internal dental epithelial cells of the sheath continue their primary function of organising the cells of the dentine papilla to form odontoblasts. After the dentine matrix is laid down they are not now required to differentiate further into ameloblasts. Invasion of the epithelial sheath by the developing fibres of the periodontal membrane takes place, the sheath breaks up and the remnants of these epithelial cells persist as residues in the periodontal membrane (Figs. 12 and 13). These residues are known as the epithelial rests of Malassez and consist of cells which have completed their functional cycle.

There are, therefore, two known types of residues concerned with dental epithelium, one consists of remnants of the dental lamina and is composed of highly potential cells and the other consists of epithelial rests of the periodontal membrane and these are cells which have completed their function. Histological evidence illustrating the effect of further stimulation of these two types of residues became available during an investigation of an infective lesion in a child aged 5½ years.

Case 1.

An acute infective lesion was present in the second lower deciduous molar region of a child aged 5½ years. The molar was extracted and a mass of tissue was found to be present between the roots. The specimen was sent for histological examination as it was thought that the tooth germ of the developing pre-molar might also have been removed. However, this was found not to be the case, the mass of tissue being simply infected granu-

lation tissue. The tooth was decalcified and serial paraffin sections were prepared. Examination revealed certain points which are of interest in relation to the present study.

Fig. 14 shows one section of the series with the mass of infected granulation tissue between the roots. Four areas marked A, B, C and D are of considerable importance and high magnification of these fields are illustrated in Figs. 15 to 18.

Fig. 15 from area A shows the presence of normal epithelial rests (E.R.) in the periodontal tissue.

Fig. 16 from area B shows this epithelium proliferating in infected granulation tissue. This is the typical appearance of a dental granuloma containing proliferating epithelium of the stratified squamous type.

Fig. 17 from area C shows proliferating cells of the dental lamina which were associated with the developing permanent tooth, the second pre-molar. Under higher magnification (Fig. 18) the more highly differentiated lamina cells are apparent. In the area marked C the typical columnar cell is seen. Elsewhere in this field the peripheral cells appear cuboidal, but are in fact, columnar cells cut transversely. (The shape of these cells in relation to the plane of section is a very important point in identification and the need for the cutting and examination of serial sections is essential.) It is interesting to note this appearance bears some resemblance to a group of cells seen in an adamantinoma at the pre-cystic stage of development. In fact, if a normal dental lamina be compared with such an adamantinoma a striking resemblance is seen. Fig. 19 is a high magnification of the dental lamina illustrated in Fig. 3, with the marginal columnar cells and intermediary cells continuous with those of the surface epithelium. Fig. 20 is a clump of cells taken from adamantinoma before any degeneration of the central cells has occurred. Finally Fig. 21 from area D shows a layer of the highly specialised ameloblast cells which have been dragged away from the enamel surface of the developing pre-molar. This case serves to illustrate the morphological difference between an abnormal proliferation of epithelial rests of the periodontal membrane and a proliferation of the embryonic dental lamina cells. The similarity of the latter with the histological appearance of early adamantinoma is evident. In the same case the morphological difference of the highly specialised ameloblasts is illustrated. For purposes of clarity the stage of development of the teeth and jaws in a normal child aged 5 years 6 months is shown in the radiograph reproduced in Fig. 22.

Case 2.

Case 2 is a specimen of a complex composite odontome removed from the lower jaw and sent for histological examination. In order to retain the structure of any enamel present and at the same time to cut serial sections the specimen was prepared by the special method adopted for this purpose⁹. Fig. 23 is a photomicrograph under low magnification of the complete specimen. The tooth was situated at the lower border of the mandible. In a recent article on primary epithelial tumours of the jaw Hewer¹⁰ excludes any consideration of odontomes on the grounds that they are "congenital malformations or else result from inflammation of the tooth germ." However, no odontome consisting of irregular masses of the calcified dental tissues could arise without the presence and influence of dental epithelium. As this case shows, it is possible that some relationship between such an odontome and an adamantinoma may exist. No dentine is produced in a typical adamantinoma but if by chance the epithelial cells reached a degree of differentiation necessary for the formation of dentine and the matrix was laid down, however irregularly, then it would be reasonable to suppose that further differentiation of the columnar epithelial cells would occur, and ameloblasts would develop with the subsequent formation of enamel matrix. The histological examination of this specimen affords evidence that such a contingency may well arise. Fig. 24 is a photomicrograph of the central area of the mass showing the irregular and disorderly distribution of dentine (D) and enamel (E).

Fig. 25 shows that differentiation of ameloblasts has been achieved and the typical appearance of these highly specialised cells forming enamel matrix is seen. Nearer the surface of the mass a surprisingly different picture was seen. This is illustrated in Fig. 26 where the typical arrangement of the epithelium of adamantinoma is depicted. There are the well-defined clumps with tall columnar marginal cells and the central cells showing the suggested resemblance to stellate reticulum as seen under low magnification. Under high magnification (Fig. 27) the typical picture of adamantinoma prior to cystic degeneration of the central cells is seen. Here the morphological resemblance of these cells to the marginal and intermediary cells of a dental lamina is again striking. The variation in the shape of the marginal cells is due to their orientation and plane of sectioning.

Whatever the correct explanation of this case may be, a study of serial sections makes it evident that the whole of this tumour has

been produced under the influence of the specialised dental epithelium which towards the surface shows a picture of typical adamantinoma with all its cellular characteristics prior to cystic degeneration.

DISCUSSION.

Adamantinoma has frequently been described as having histological features which correspond to the enamel organ but without enamel-forming properties.

This may be true of certain cells of the enamel organ which have attained a stage of development prior to the formation of odontoblasts and dentine matrix.

Champion, Moule and Wilkinson¹¹ have observed that the one characteristic by which this type of tumour can be distinguished from the squamous celled or basal celled carcinoma is by the differentiation of the peripheral layer of cells into long columnar cells that resemble internal dental epithelium.

It is extremely important to appreciate the part that epithelium plays in tooth development before considering the nature of certain epithelial tumours of the jaws. A lack of appreciation of the need for a detailed study of tooth development has undoubtedly been responsible for many misconceptions concerning the nature of, and even what is meant by, adamantinoma. It would, therefore, serve no useful purpose to refer at length to the confusing statements that have appeared in the more recent literature on the subject. The main purpose of this communication is to submit and illustrate certain special features of tooth development and other evidence in support of the hypothesis that a typical adamantinoma is a tumour essentially of dental origin and that it may arise from cell residues of the dental lamina.

The differential diagnosis of basal cell carcinoma and adamantinoma is of some clinical importance. A basal cell carcinoma responds more readily to deep X-ray therapy, and while some success is claimed for this treatment of adamantinoma, it is more often regarded as being unsatisfactory and disappointing. Davis¹² in a recent investigation of this found that necrosis of the bone, osteomyelitis and burning of the mucosa and skin have occurred without any benefit but with considerable misery to the patient, and that while X-ray photographs may indicate some superficial improvement, the more inaccessible deep portions of the tumour remain with subsequent recurrence. It appears reasonable to expect

that in the case of adamantinoma whose cells have undergone a marked degree of differentiation there would not be a ready response to X-ray therapy. There are cases when considerable difficulty has been experienced in histological diagnosis, where it is important to recognise even slight degrees of cell differentiation in a tumour tissue. For reasons already stated, whenever doubt is felt, the examination of serial sections should be undertaken.

It is hoped that a further detailed study of the morbid histology of epithelial tumours of the jaws, taking into consideration the normal histology and physiology of the epithelium concerned with all stages of tooth development, may help to clear up some of the confusion that has arisen.

ACKNOWLEDGMENTS.

My thanks are due to Mr. G. Hoggins and Mr. Paul Toller for the clinical material and to Miss M. F. Newstead for her help in the preparation of the manuscript. I am indebted to Mr. E. B. Brain, Mr. C. Lees and Mr. G. A. Johnson for their excellent work in the preparation of the sections, photomicrographs and lantern slides.

I wish to express my appreciation to Dr. E. A. Marsland for his valuable share in the work on tooth development.

REFERENCES.

1. Schulenburg, C. A.—Annals Royal College of Surgeons: 8:329, 1951.
2. Willis, R. A.—Pathology of tumours: London, Butterworth & Co., 1948, p. 315.
3. Warwick James W., and Wellings A. W.—Dental Epithelium and its significance in tooth development: Proc.Roy.Soc.Med., 37:1 1943.
4. Willis, R. A.—Pathology of tumours: London, Butterworth & Co., 1948, p. 309.
5. Glasston, S.—J.Anat., 70:260, 1935.
6. Lucas, R. B. and Thackray, A. C.—Brit.J.Cancer, 5:289, 1951.
7. Marsland, E. A.—Histological investigation of amelogenesis in rats—I. matrix formation: Brit.D.J., 91:251 (Nov. 20) 1951.
8. Marsland, E. A.—Histological investigation of amelogenesis in rats—II. maturation: Brit.D.J., 92:109 (Mar. 4) 1952.
9. Brain, E. B.—A method of preparing decalcified serial sections in paraffin wax of human enamel and dentine in situ: Brit.D.J., 87:199 (Oct. 21) 1949.
10. Hewer, T. F.—Primary epithelial tumours of the jaws: J.Clin.Path., 5:225, 1952.
11. Champion, A. H. R., Moule, A. W. and Wilkinson, F. C.—An ameloblastoma of the mandible: Brit.D.J., 90:143 (Mar. 20) 1951.
12. Davis, E. D. D.—The multilocular cystic tumour or adamantinoma of the jaw: The Lancet 258:862 (Oct. 25) 1952.

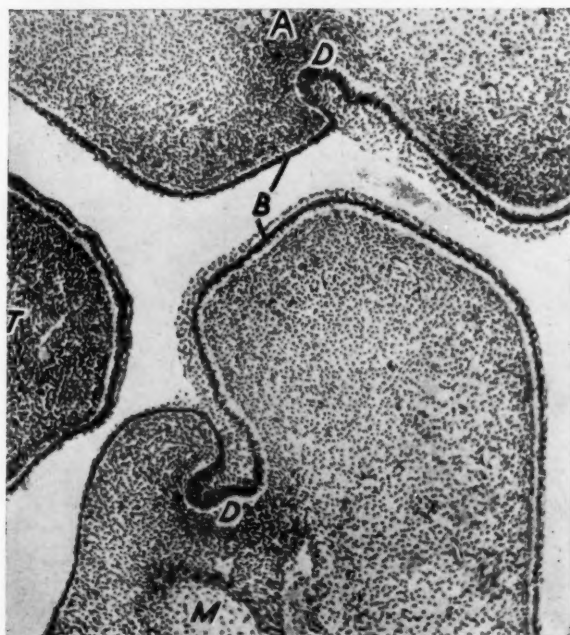


Fig. 1. Early stages of tooth development. Sagittal section through the upper and lower jaws in the human embryo (7-8 weeks) in the incisor region. x 40.

- B. Basal cells of oral epithelium.
- D. Differentiating columnar cells of dental epithelium.
- T. Tongue.
- M. Meckel's cartilage.
- A. Dental anlage in upper jaw.

Fig. 2. "Cap" stage of tooth development. Human embryo (11-12 weeks). x 100.

- E. External dental epithelium.
- I. Internal dental epithelium.
- D.L. Dental lamina.
- M. Meckel's cartilage.
- B. Bone of mandible.

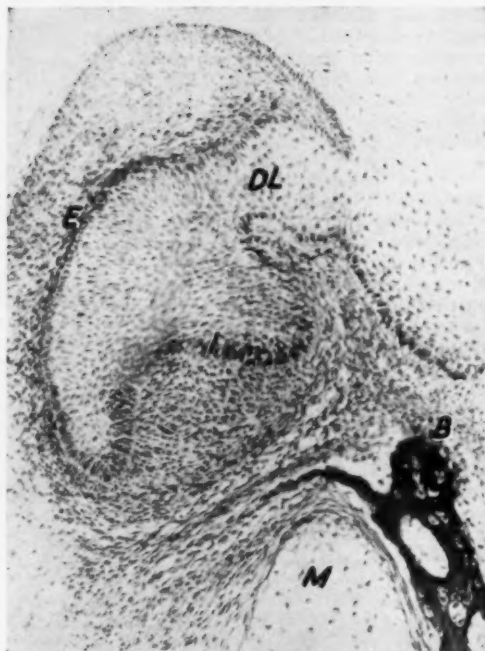


Fig. 3. "Bell" stage of tooth development. Human embryo (15 weeks). x 60.

- O.E. Oral epithelium.
- D.L. Dental lamina with lingual extension (L) for permanent tooth.
- E. External dental epithelium.
- I. Internal dental epithelium.
- S. Stellate reticulum.
- D.P. Dentine papilla.

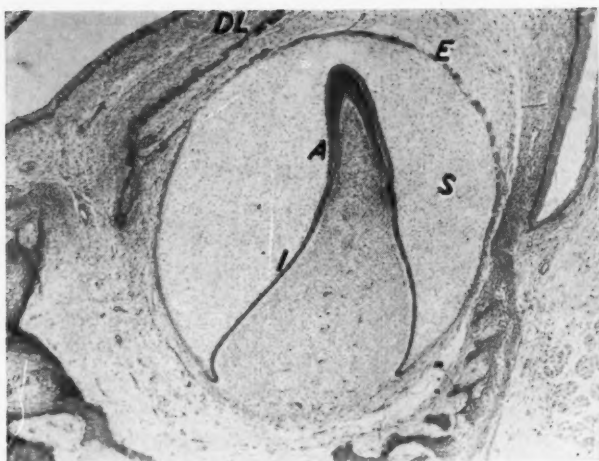


Fig. 4. Commencement of dentine and enamel formation. x. 32.

- E. External dental epithelium.
- I. Internal dental epithelium.
- A. Ameloblasts.
- D.L. Dental lamina.
- S. Stellate reticulum.

Fig. 5. Higher magnification of field in Fig. 4, showing first formed dentine (D) and enamel matrix (E). x 100.

- O. Odontoblasts.
- A. Ameloblasts.
- I. Internal dental epithelial cells.
- P. Pulp.
- S. Stellate reticulum.
- S.I. Stratum intermedium.

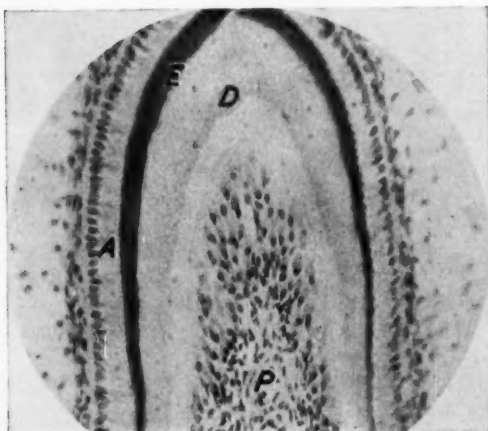
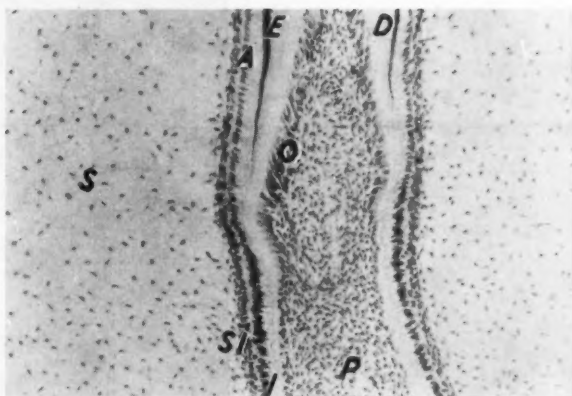


Fig. 6. Higher magnification of fully differentiated ameloblasts forming enamel matrix. x 190.

- P. Pulp.
- D. Dentine.
- E. Enamel.
- A. Ameloblasts.

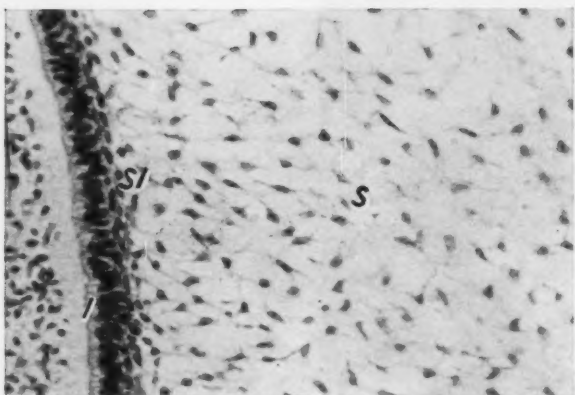


Fig. 7. Stellate reticulum of enamel organ (S). x 280.

S.I. Stratum intermedium.

I. Internal dental epithelium.

Fig. 8. Clump of cells from adamantinoma. x 175.

Showing degeneration and breakdown of central cells.

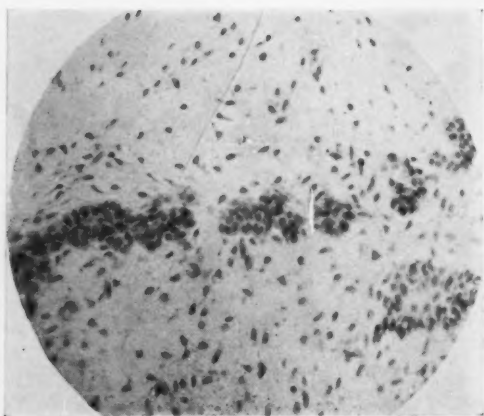
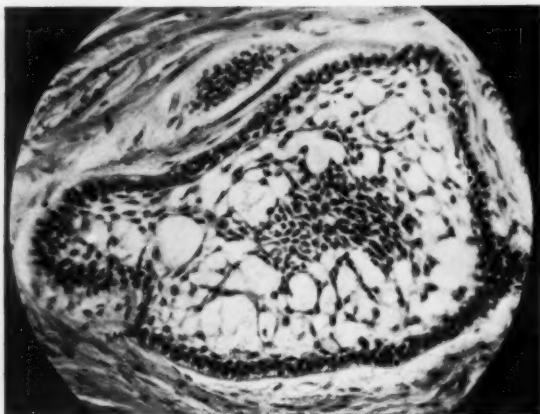


Fig. 9. Group of cells formed by the breaking up of the dental lamina. x 190.

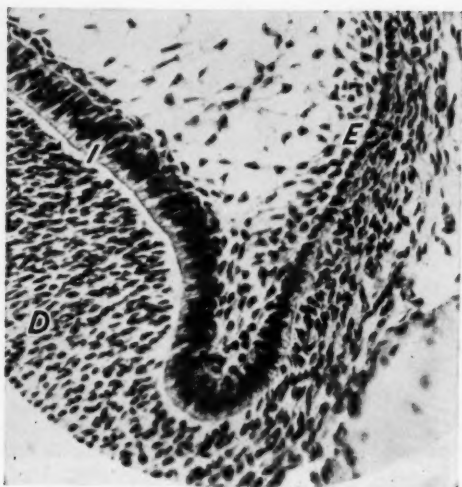


Fig. 10. Marginal fold of the enamel organ. x 228.

- I. Internal dental epithelium.
- E. External dental epithelium.
- D. Dentine papilla.

Fig. 11. Approximation of internal and external dental epithelial cells of the marginal fold of the enamel organ. x 250.

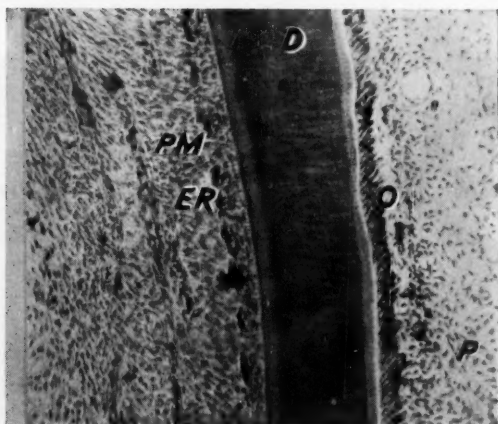
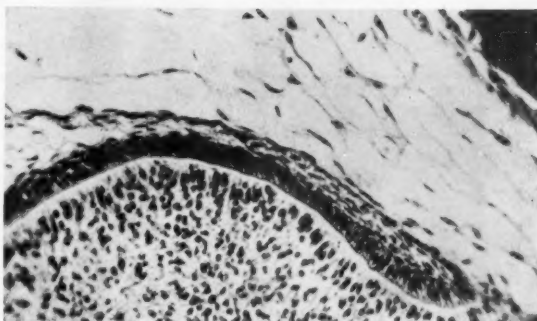


Fig. 12. Formation of epithelial rests (E.R.). x 100.

- P.M. Developing periodontal membrane.
- D. Dentine.
- O. Odontoblasts.
- P. Pulp.

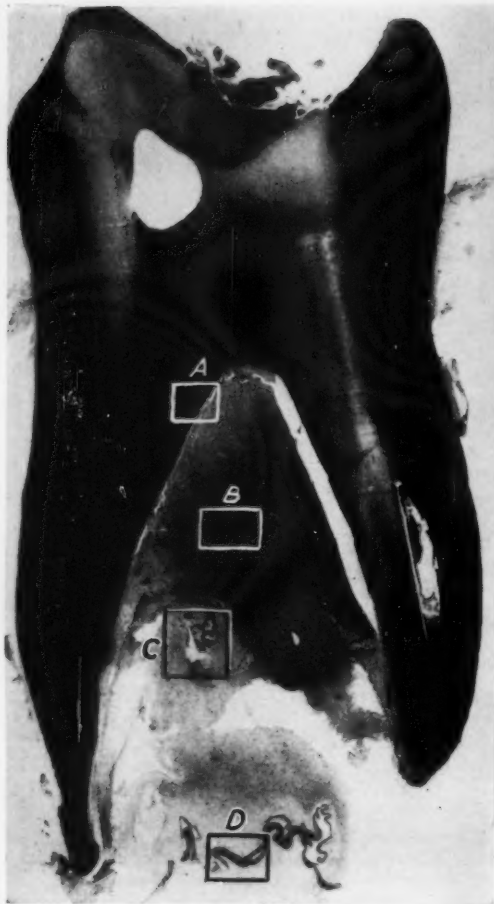


Fig. 13. Higher magnification of group of cells forming an epithelial rest. x 335.

Fig. 14. Decalcified section of lower deciduous second molar. x 8.

A, B, C and D, areas for examination under higher magnification.

Fig. 15. Area A (Fig 14). Epithelial Rests (R) adjacent to tooth surface. x 280.

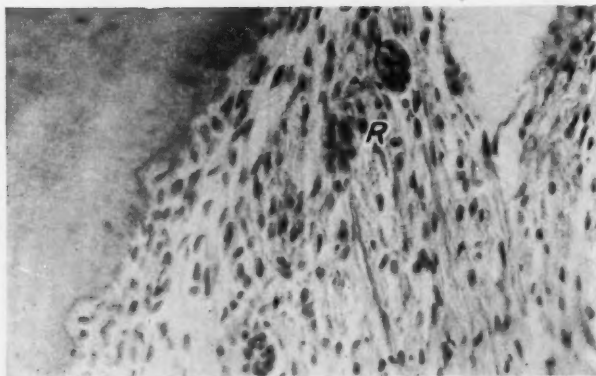




Fig. 16. Area B (Fig. 14). x 80. Proliferating epithelium in infected granulation tissue.

Fig. 17. Area C (Fig. 14). Proliferation of cells of the Dental Lamina associated with developing premolar. x 45.

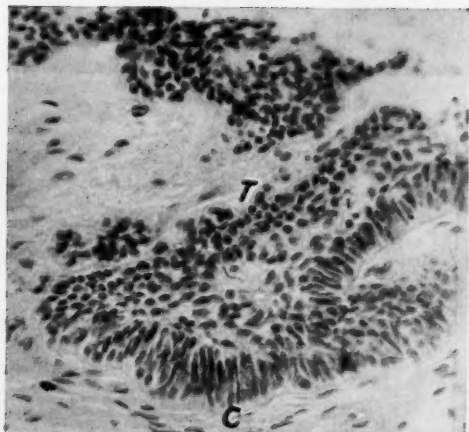
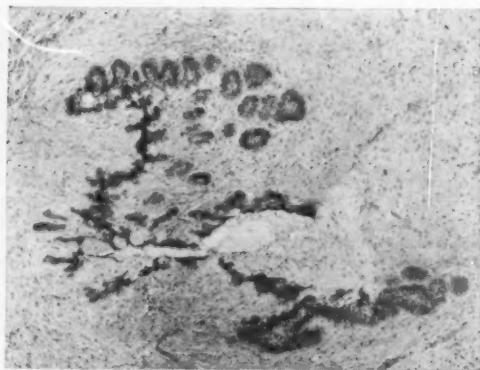


Fig. 18. Higher magnification of group of lamina cells (Fig. 17). x 280.

C. Typical columnar cells.

T. Columnar cells cut transversely.

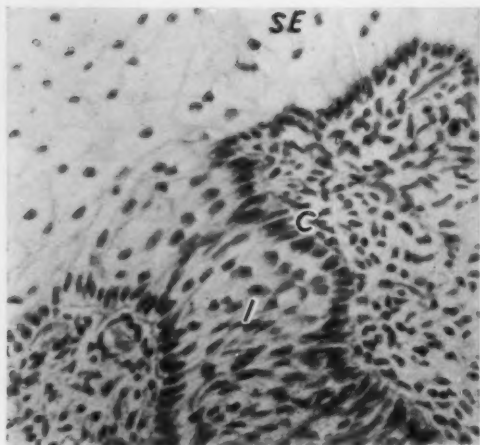


Fig. 19. Normal Dental Lamina. x 335.

C. Marginal columnar cells continuous with basal cells of surface epithelium (S.E.).

I. Intermediary cells continuous with prickle cells of surface epithelium.

Fig. 20. Section of early adamantinoma. x 280. Showing clump of cells prior to central breakdown.

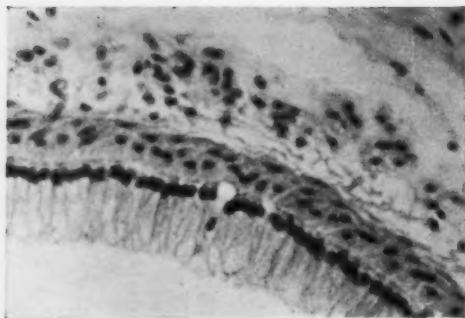
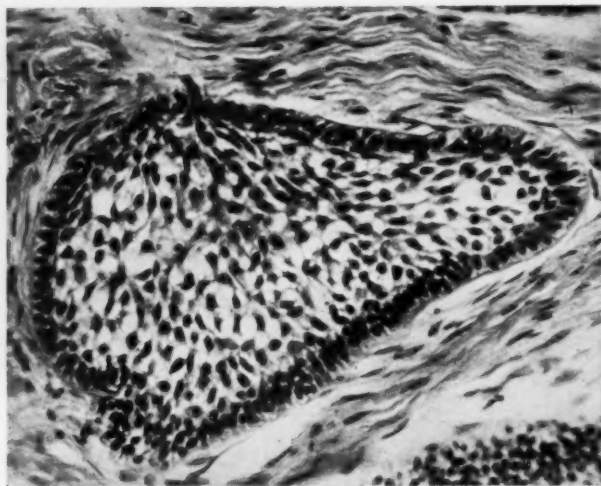


Fig. 21. Area D (Fig. 14). x 335. Layer of ameloblasts, dragged away from surface of developing enamel of premolar. External enamel epithelium and stratum intermedium cells also present.



Fig. 22. Radiograph of mandible of a child aged 5 years 6 months.

Fig. 23. Decalcified section of odontome. x 5.

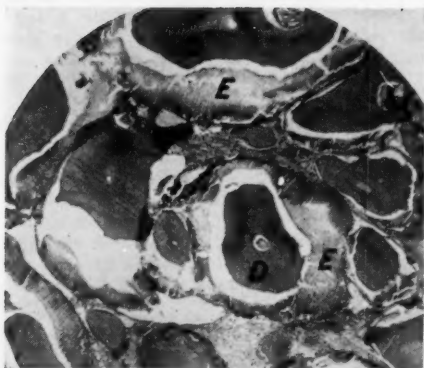


Fig. 24. Irregular masses of dentine (D) and enamel (E). x 30.

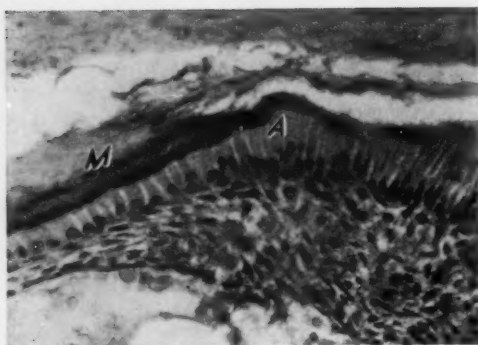


Fig. 25. Higher magnification of area showing differentiated ameloblasts (A) forming enamel matrix (M). x 250.

Fig. 26. Surface area of specimens showing clumps of epithelial cells forming typical adamantinoma pattern. x 35.

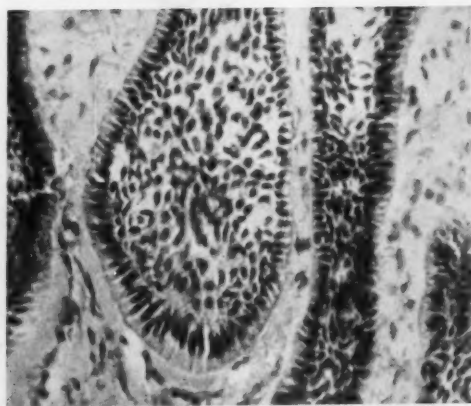
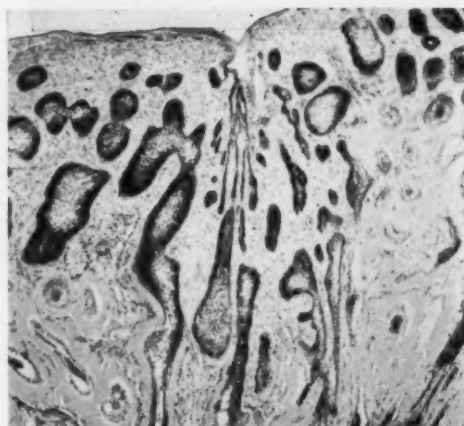


Fig. 27. Higher magnification of Fig. 26. x 300. Showing typical appearance of the peripheral and central cells of adamantinoma prior to cystic breakdown.

Making The Most Of Your Materials*

A. R. Docking, M.Sc., F.R.A.C.I.†

"PROPER MATERIALS, PROPERLY USED"

(W. Souder)

As far as dental materials are concerned, there are obviously two factors to be considered—the selection of the right product, and the right method of use. First, it is more difficult, although not necessarily impossible, to make a success of an inferior product for one is handicapped from the very start. To make the most of such a material, the technique would have to be adjusted to suit sometimes to the point of inconvenience.

Through its Standards Committee, the Australian Dental Association has taken steps to bring to the notice of its members those products which the manufacturers certify to meet the requirements laid down and which the Committee are satisfied will do so consistently. Such a list was published recently¹ and should be used as a purchasing guide or to check whether the products of choice are included.

It may be difficult to make good with an inferior material, but on the other hand it is a very simple matter to spoil a good product by incorrect handling. This discussion will be limited to a consideration of several commonly-used materials and some of the pitfalls to be avoided in their use will be pointed out.

CONSERVATIVE DENTAL MATERIALS

Tungsten carbide. Though not a material in the sense of materials used in bulk by the dentist, tungsten carbide has nevertheless become an important substance through its use in burs. Various complaints received confirm that its greatest disadvantage is the tendency for the blades to chip, particularly at the angular tips of fissure and inverted cone burs, or for the whole head to fracture. It appears that a change in technique is indicated for this type of bur and Lammie², states that:

this is often difficult to accomplish because it involves supplanting operative movements of the hands that have become almost reflex (by continued use of steel burs).

It is recommended² that only the round burs should be used for the original opening-up of the enamel surface and the force should be applied vertically. With fissure burs, one should make sure that the end of the bur cuts only in dentine and that the whole cutting face makes contact with the tooth surface to be cut. It should never be used for plunge

cutting. Chipping of the weak angular edges will occur if inverted cone burs are applied to enamel surfaces. The bur should be running in the handpiece whenever it is applied to or removed from the tooth surface. The breaking of the cutting head of the fissure bur is most commonly due to a sweeping side-to-side movement of the handpiece. This may be satisfactory for a steel bur but is risky and unnecessary with tungsten carbide.

A further point to remember in the proper care of tungsten carbide burs is that the cutting head is made from particles sintered together with cobalt. This metal is subject to attack by some types of sterilising agents and if sufficient cobalt is dissolved, the edges of the blade will disintegrate. Iodine, eusol, trichlorophenol, and hydrogen peroxide were found³ to attack the cobalt, and there is also some evidence that Zephiran and Cetavlon may be deleterious.

Amalgam. The most commonly-used filling material is silver-tin amalgam and although the precautions to be observed in handling this material are already familiar, it will be profitable to reconsider a few features. Beginning with alloy/mercury ratio, it has been confirmed in a series of strictly-controlled experiments⁴ that this factor is relatively unimportant as far as the physical properties of the amalgam are concerned, provided that sufficient care is taken in expressing the excess mercury. If there is excess residual mercury, it will affect the strength of the amalgam and, which is most important, it will greatly lower the tarnish and corrosion resistance of the restoration so that it will not take or retain a satisfactory polish.

The alloy particles usually have a film of oxide which impedes the penetration of mercury, but grinding or shaking the material exposes fresh surfaces which are more readily susceptible to amalgamation. With modern products, the provision of clean surfaces can be achieved not only by grinding in a mortar but by mixing in a finger stall or in the capsule of a mechanical amalgamator. Some alloys are supplied already "pre-amalgamated" by a surface treatment with mercury which hastens the amalgamation process. Over-trituration by too great a pressure or for too long a period can give rise to shrinkage, particularly during the early stages of setting, and some products are found⁴ to be much more susceptible than others to such mishandling.

The effect of over-trituration, with resulting inferior dimensional change properties,

*From a lecture to the Australian Dental Association, New South Wales Branch on 25th May, 1954.

†Officer in Charge, Commonwealth Bureau of Dental Standards.

was emphasised when a survey³ was conducted amongst a number of dentists practising in a city building. Using alloys which were known from previous tests to comply with Australian Dental Standard T.2, it was found that, with one or two exceptions, the amalgam produced by the dental assistants gave a contraction instead of an expansion at 24 hours. The contractions varied up to 17 microns per cm., which result should be compared with the specified requirement for expansion of 2 to 15 microns. It is not claimed that such amalgams will invariably fail: in fact, there is reason to believe from some overseas investigations on contracting amalgams that the specification requirements are largely theoretical in this regard. It is hoped that work in this field will be undertaken, particularly with a view to amending the requirements of the present Australian Standard, but until more is known about the clinical implications of dimensional change, it would be wise to use a technique that would be expected to cause a slight expansion of the restoration to ensure that the cavity will be tightly packed.

On the other hand, as Phillips⁴ has stressed, there are dangers associated with under-trituration, such as drastic loss of strength and a greater susceptibility to tarnish and corrosion. An under-trituration mix is also more difficult to handle because of its rapid setting and rough carved surface. Some compromise is necessary here, and taken all round it may prove safer to err a little on the generous side as far as amalgamation is concerned.

For strength and minimal residual mercury content, the importance of using high pressures in the packing of amalgams cannot be too strongly emphasised. It is essential to see that the amalgam is confined as much as possible when packing and the proper use of matrix bands is most important.

Finally on this subject of amalgam mixing, in spite of frequent warnings of its dangers, techniques are still being used which allow the risk of incorporation of moisture either from the operator's hands or from the patient's saliva. If the alloy contains zinc, as the great majority of them do, moisture can be decomposed into hydrogen which, being confined under great pressure, will cause excessive "delayed" expansion. All certified dental amalgam products carry a warning against mulling in the hand or the incorporation of moisture by other means.

Silicate cements. Silicate cements consist essentially of a type of powdered glass. The maximum strength and resistance would be exhibited by this glass if it were in the form of a single homogeneous block. As this is impracticable except by the use of porcelain

inlays, the ideal is to pack as much of the glass powder into a given volume as possible, thereby approaching as closely as possible the properties that would be given by a solid block. To do this, the maximum amount of powder to a given volume of the cement liquid should be used. Obviously there is a limit to this as the material would be useless if there were not sufficient phosphoric acid to react with all the particle surfaces and cause them to adhere and, furthermore, a suitable consistency must be produced for proper manipulation of the cement and its insertion into the cavity. The silicic acid gel which provides the adhesion is responsible for practically all of the disabilities of silicate restorations. It is weak and brittle, porous, readily susceptible to staining, partially soluble and is acid in nature: in other words, it is the very opposite of the "porcelain" one is aiming to achieve. In the manipulation of a silicate cement one should therefore strive to incorporate the maximum of powder as practicable. Any device or technique which works towards this end is desirable; for example, the use of a chilled mixing slab, spatulation on the minimum area of the slab and as short a mixing time as practicable.

It is of interest that in recent experiments at the U.S. National Bureau of Standards⁵ the ultimate in incorporating a very high proportion of powder has been virtually reached by departing from the conventional method. The powder is placed in a rubber sac which is then immersed in iced water; a measured amount of liquid can be injected with a syringe and the cement mixed by kneading in the fingers. By this means the best properties are obtained quite independently of atmospheric conditions and this should prove of value particularly in tropical climates.

A further point with silicate cement is the necessity to exclude moisture during the setting action. Any dilution of the acid at this stage is disastrous. Once the setting has been completed, the cement must be kept wet, for it shrinks on drying and this shrinkage is only partially reversible. Successive moistenings and dryings ultimately produce a weak and cracked material.

The best finish that can be obtained on a silicate restoration is that given by the matrix strip. Any attempt to polish results in the tearing out of the harder particles from the matrix, leaving a surface which, microscopically at least, is not perfectly smooth.

Direct filling resins. This subject has been covered in a paper published in a recent issue of this Journal⁶. Since that paper was first given, nothing much has come to light to change the ideas expressed in it; in fact, further correspondence and literature from

overseas have supported them. Although manufacturers are making efforts to rectify the deficiencies of acrylic resins for direct restorations, their relatively high co-efficient of thermal expansion, low modulus of elasticity and bacteriological inertness can still lead to failure. To minimise the effects of these properties, the recommendations already noted⁸ are worth repeating:

1. Avoid all types of cavity where the use of acrylic resin is contra-indicated by theory or experience.
2. Choose the most recently developed products known to have good colour retention.
3. Follow the manufacturer's directions carefully.
4. Maintain a dry field, using rubber dam if necessary.
5. Use a suitable cavity lining.

Whether the cavity lining is bacteriostatic or not, in the thermal cycles that occur it adheres preferentially to the tooth substance and not to the acrylic resin with the result that any leakage that occurs will do so between the resin and the lining.

PROSTHETIC DENTAL MATERIALS

As it is not possible to deal adequately with the wide variety of materials used in dental prosthetics, some features upon which work has recently been carried out will be mentioned.

Impression materials. In regard to hydrocolloidal materials, the older alginate types did not seem to produce the same dimensional accuracy as the reversible (agar) impression materials but considerable improvement has now been effected through new formulations. The mixing of alginate impression material should be thorough and vigorous⁹. The initial mixing should be controlled to ensure thorough wetting of the powder then the mixture spatulated energetically, working the material against the side of the bowl.

Hydrocolloid impressions of whatever type should be removed with a sharp thrust in a direction parallel to the long axis of the teeth. Sudden forces give greater strength and less permanent set, whereas slow rocking or weaving out of the impression increases the possibility of distortion and fracture in critical areas⁹. Use a fixing solution if the manufacturer recommends it to accelerate the setting of the stone or plaster and so prevent a "chalky" surface.

Whatever hydrocolloidal impression material is used, it is important to realise that the safest rule is to cast the model immediately. Different materials react differently to the various methods of storage and one cannot be certain that dimensional accuracy will be re-

tained. Storing in a damp cloth seems to be much better than storage in water or potassium sulphate solutions. Both these methods are much superior to storage in air but it is almost impossible to predict what changes will take place, particularly with alginates. The question of storage is readily avoided by adopting the practice of pouring casts immediately.

Gypsum products. Plaster and artificial stone are very common materials, but should not be treated too casually on this account. For strength and hardness of surface thick mixes must be used with suitable spatulation and mild vibration. If expansion is desired to compensate for the shrinkage of acrylic resin the type known in Australian Dental Standard T.7 as the Type B artificial stone should be used; such stones show expansions between 0.30 and 0.45 per cent. On the other hand, for minimal expansion Type A stones, which give expansions of less than 0.20 per cent., are used.

There has been an interesting development overseas in regard to very high strength artificial stones, which are particularly useful for dies. When water is mixed with plaster or artificial stone, only a certain proportion of that water combines chemically to form the gypsum model and the remainder is held in the interstices. The reason why artificial stone is stronger than plaster is due not necessarily to a difference in particle size but to the greater compactness of the particles, resulting in a lower water demand to attain suitable consistency and flow properties. This difference is achieved in the calcining process, the base of artificial stone being made by autoclaving in such a way that the moisture escapes gradually, instead of rapidly and destructively with dry heat calcining. Manufacturers have now gone one step further, and by using certain chemicals in the autoclave, particles of maximum compactness are obtained¹⁰. These very high strength materials require only about 20 parts of water to 100 parts of powder, which is approaching the theoretical amount of water required for hydration. The low proportion of water required enables the practitioner to achieve maximum strength and hardness, but he only does so when he observes the proper water/powder ratio.

Separating media. While it is realised that the use of tinfoil adds to the task of preparing a denture, overseas reports¹¹ continue to show the great difference in the properties obtained between resins cured against tinfoil and those cured against tinfoil substitutes—in particular against alginate separating media. With the latter, there is greater surface stressing and liability to warpage and sometimes a

whitening is produced. Considerable work with some products has led to the elimination of the causes of the whitening effect sometimes produced against alginate films, but the question of internal stressing remains.

Acrylic resins. The usual precautions in the use of acrylic resins are well known and should always be observed if a denture free from porosity is to be obtained. There is still a danger of under-curing if the low-temperature cure is used—at least 9 hours processing at 160°F seems to be required if the case is not boiled. With some products on the market, it has been found that even 9 hours at 160°F are insufficient to produce the strength characteristic of the resin when cured by a boiling process. One of the chief troubles is the residual monomer which can affect the properties of the resin.

For repairs with acrylic resin, rounded edges and softening of the ends to be joined are recommended¹² for best results. With these precautions, joins as strong as the original material can be achieved.

Self-hardening resins. Self-hardening resins have been found useful in minor repairs and in some recent developments the use of these resins for complete dentures has been considered. These resins possess the advantage of less dimensional change during processing and also less internal stress, but they suffer from slight colour instability, they do not make a good union with plastic teeth or old resin and they have a lower transverse strength than the heat-cured material^{13, 14}.

CASTING MATERIALS

Wax. It is a truism that, in the lost wax investment technique, the casting cannot be more accurate than the wax pattern. Few realise just how wax patterns will distort after removal from the tooth, particularly if given time; and the higher the temperature, the shorter the time required. Wax is perhaps the weakest link in the casting chain. There is only one really safe way of treating an inlay wax pattern and that is to invest it immediately¹⁵. It is not so very inconvenient to invest immediately, for having done this, the burning out and casting can be done at leisure; once the mould has been formed and hardened, the dimensional changes are minimal. If it must be stored, it should be refrigerated.

Investments. In these days, the importance of good investments and investing techniques is well recognised. For the best finish on a casting, a low mould temperature is preferable, and this is permissible with a cristobalite investment or one that achieves the necessary expansion by hygroscopic means. With high-expanding investments, heating should not be too rapid, otherwise cracks may occur giving

flaws on the casting. To obtain the best out of an investment, thick mixes should be made and adequate wet asbestos liners should be used to allow full hygroscopic and thermal expansion. Vibration of the pattern when in contact with the investment may give rise to air bubbles which are likely to attach themselves to the pattern¹⁶. These bubbles sometimes enter if the ring is not properly sealed by the crucible former. It is usually taught that porosity around the sprue is due to shrinkage or not filling the mould before the metal freezes in the sprue. Workers at Massachusetts Institute of Technology¹⁷ present a different picture, suggesting that if the metal enters the cavity too fast, it compresses the air to such an extent that it is forced back and causes voids. They suggest slowing down the flow of gold by flattening the ends of the sprues or by using fewer and smaller ones. Also, the sprues should be set so that the metal does not hit an interior wall at right angles and there should never be more than $\frac{1}{4}$ inch of investment between the wax pattern and the base of the investment.

Castings should be made within one minute of removing the inlay ring from the furnace, otherwise the mould may cool sufficiently to cause a notable loss in dimension due to thermal shrinkage¹⁶.

REFERENCES

1. Australian Dental Association—List of certified dental materials: D.J.Australia, 26:156 (Aug.) 1954.
2. Lammie, G. A.—Critical review of cutting instruments in cavity preparation 2. The tungsten carbide bur: Internat.D.J., 4:43 (Sept.) 1953.
3. Lammie, G. A. and Sandford, E. J.—Effect of sterilising agents on tungsten carbide burs: Brit. D.J., 94:171 (April 7) 1953.
4. Ware, A. L. and Docking, A. R.—To be published.
5. Ware, A. L.—Report on a survey of the treatment of silver alloy amalgams: Unpublished C.B.D.S. Report, (Feb. 5) 1951.
6. Phillips, R. W.—Amalgam—Its properties and manipulation: New York J.Den., 23:105 (March) 1953.
7. Grunewald, A. H., et al.—Silicate cement: method of mixing in a closed container to prevent effects of exposure to atmosphere: J.A.D.A., 46:184 (Feb.) 1953.
8. Docking, A. R.—The present status of self-hardening resins in conservative dentistry: D.J.Australia, 26:21 (Feb.) 1954.
9. Osborne, J., and Lammie, G. A.—The manipulation of alginate impression materials: Brit.D.J., 96:51 (Feb. 2) 1954.
10. Eberl, J. J., and Ingram, A. R.—Process for making high-strength plaster of paris: Ind.Eng.Chem., 41:1061 (May) 1949.
11. Fairhurst, C. W., and Ryge, G.—Tin-foil substitute: Warpage and crazing of acrylic resin: J.Prod.Den., 4:274 (March) 1954.
12. Ware, A. L., and Docking, A. R.—The strength of acrylic repairs: D.J.Australia, 22:261 (June) 1950.
13. Caul, H. J., et al.—Properties of self-curing denture base resins: J.A.D.A., 44:295 (March) 1952.
14. Osborne, J.—Acrylic resins in prosthetic dentistry: Internat.D.J., 4:299 (March) 1954.
15. Phillips, R. W., and Biggs, D. H.—Distortion of wax patterns as influenced by storage time, storage temperature, and temperature of wax manipulation: J.A.D.A., 41:28 (July) 1950.
16. Skinner, E. W.—Dental materials: J.Tennessee D.A., 32:415 (Oct.) 1952.
17. Joy, W. A.—Porosity in gold castings: J.Prod.Den., 4:98 (Jan.) 1954.

The Selection And Design Of Retainers For Efficient Partial Dentures*

H. P. Assheton-Chin B.D.S. (Syd.), D.M.D. (Harvard)

The title of this paper may give the impression that I intend describing all types of clasps, giving them an efficiency rating. However, that is not practicable because of various factors such as length of tooth, shape, rotation or the use of stress breaker, a clasp that is highly efficient as a retainer on, say, an upper bicuspid in one case, may be useless on the same tooth in another case. Rather, I hope to deal with some of the principles of retention and describe how various types of clasps operate in relation to these principles.

Factors in Retention.

The word retention connotes primarily the gripping or clutch action of a clasp. This is influenced by tension, length, mass and cross sectional shape of the clasp arm.

Tension: If it is too great, trauma of the clasped tooth will result; if it is too little there will be movement during use.

Length: If the mass and tension of the clasp are correct but if it is too long it will not hold the denture firmly because there will be too much "whip" in it. If the clasp is too short, mass and tension again being correct, it will be too rigid to go over the bulge of the tooth into the correct undercut.

Mass: If the length is correct but the clasp is too thin, it will not have enough mass to maintain the correct tension: if it is too thick, it will be too rigid. In either case the correct resiliency will not be achieved.

The remarks about these three factors, tension, length and mass, refer only to the retaining arm of the clasp, not the reciprocating arm, which, of course, must be always rigid.

Cross Sectional Shape of Clasp Arm: This is closely linked with the other three factors. A clasp that has a flat tissue surface and a convex outer surface (not necessarily half round, but approaching it) will have greater resiliency and strength than a flat clasp, just as, in engineering, angle iron is stronger than a flat bar of the same bulk, or as a piece of corrugated iron resists distortion better than a flat sheet of iron of the same gauge.

It is important that a clasp be tapered from its base towards its free end, as it increases resiliency. Such tapering plays a large part

in allowing a fishing rod or a rapier to be bent almost double, not break, and return to its original shape when released.

Stabilisation: This factor in retention is influenced by thickness, cross sectional shape, the tension of the clasp arm and the width of the occlusal rest. One sees many badly designed occlusal rests. Many are too narrow bucco-lingually, having long tongues extending half way along the occlusal surface of the tooth mesio-distally. The functional part of a rest is the shoulder, that is the millimetre or so which is in contact with the marginal ridge, or more precisely, that part prepared for the rest. If the rest is too narrow bucco-lingually it tends to allow rocking of the saddle, whereas a broader one tends to stabilise the saddle. The mariner recognises this principle when he stands with feet apart on a rolling deck, his stability being much greater that way, than if he were to stand with his feet close together. The wide occlusal rest is even more important when designing unilateral dentures.

Stabilisation is influenced by the distance between the occlusal rest and the lowest point of the clasp contact with the tooth (towards the gingival) where it comes off the saddle. A circumferential clasp starting at the occlusal rest and going down and around the tooth to a point halfway down the crown, even when it engages an undercut, does not give as much stabilising effect as a clasp that continues on and ends near the gingival margin. This principle is illustrated by a man lying prone on the top of a wall. He is easily dislodged. If he grasps the wall with his hands held close to his body he resists dislodgment better, but if he extends his arms downward at full length and presses his hands against the wall, it is quite difficult to dislodge him. Even more stabilising effect is attained if using a bar clasp it is taken off the saddle at its lowest point with its free end engaging the tooth near the gingival. This is the principle of the outrigger canoe.

Tripping Action: In addition to the above factors, Stone, of Washington, recognised the existence of another. This, he called "tripping action," in the sense of stumbling action, which operates in many of the bar clasps but not in the orthodox horizontal circumferential clasps. Both retention and stabilisation are increased by this tripping action which depends on the angle at which a bar clasp

*Read at the Australian Dental Congress, Brisbane, June, 1953.

approaches a plane tangential to the tooth undercut.

I would emphasise that all circumferential clasps (including the horizontal Jackson crib type) grasp the tooth in such a manner that the long axes of their arms are in a plane or planes parallel to the sides of the tooth as they proceed from the occlusal rests down and around the sides of the tooth. In contradistinction the long axis of the bar clasp, which usually leans somewhat towards the tooth, is not parallel to the sides of the tooth, but leads up to it at an angle. It will be realised that the horizontal clasp is taking the load of bending force at right angles to its long axis—the direction which puts the greatest strain on a cantilever and can be compared to a human arm supporting a weight when extended horizontally. The bar clasp, which leans towards the plane of the side of the tooth, takes the load, not at right angles to its long axis, but partly in line with its long axis, and therefore will resist the outward bending force better, just as the human arm would support the same weight more easily if extended vertically upward. The arm of only a bar clasp approaches the plane of an undercut at more or less a right angle: the arm of a circumferential clasp never does but is always nearly parallel to it. When a bar clasp is removed from the tooth it tends to dig in and resist displacement because of its angle of approach to the undercut. A tripping or stumbling action is encountered as it catches in any inequalities in the road surface. This effect is lacking when the stick is dragged behind at the same angle.

The nearer the plane of the undercut of the tooth is at right angles to the clasp arm, the greater will be the resistance to dislodgement, just as the nearer a stick is parallel to the ground, the easier it is to push it along the ground: increasing the angle of incidence increases the resistance encountered.

Because of their shape it is harder to push a bar clasp off the tooth than it is to put it on, and it is harder to get a circumferential clasp into place than it is to drag it off.

A simple classification would designate the bar clasp as a "push" type and the circumferential clasp as a "drag" type. All other relevant factors being equal, all "drag" types, whether they traverse the teeth horizontally, diagonally or vertically from the occlusal aspect, will retain a denture with equal efficiency because the long axes of their arms are parallel to the side of the tooth. Therefore it will be convenient for purposes of illustration to represent the action of the

horizontal and diagonal clasps by arms coming directly from the occlusal surface.

The remainder of this paper aims at demonstrating, by means of illustration, the various principles that have been described already.

Not all the clasps are drawn as they would be made on a denture. It is desired to show principles of physics and whilst angles are exaggerated for this purpose it does not affect the truth of the principles.

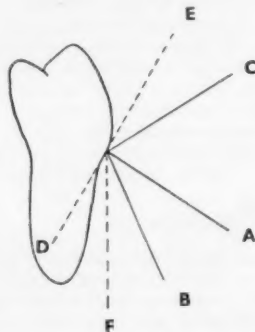


Figure 1 shows the effect of the angle of incidence of a clasp arm on tripping action.

- D. E. Tangent to plane of undercut.
- A. "Push" type clasp; maximum tripping action.
- B. "Push" type clasp; less tripping action than A; more than F.
- C. "Drag" type clasp; no tripping action.
- F. Vertical bar; none or little tripping action.

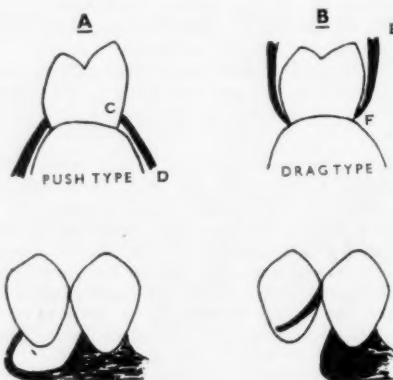


Figure 2 demonstrates that retention in a clasp of the type shown on tooth "A" is greater than in the one as shown on tooth

"B" because the inclined plane at C is more nearly at right angles to the long axis of CD, whereas the same inclined plane at F is more nearly parallel to the long axis of EF. Therefore EF will bend outwards more easily than CD with a consequent lessening of efficiency in retention.

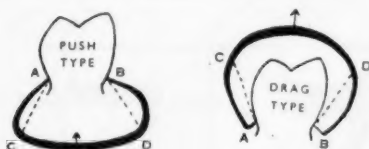


Figure 3 shows how a "drag" type clasp pulls off easier than a "push" type clasp pushes off. In the "push" type a dislodgement force applied at the arrow tends to bend the arms at rotation points C and D, forcing A and B inwards. Optimum angles of incidence increase the retention and tripping action in this type. In a "drag" type clasp the dislodgement force applied at the arrow tends to bend the arms at rotation points C and D, spreading A and B apart. Long barbs at the optimum angle of incidence are futile in this type.

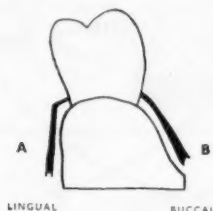


Figure 4 shows the variation in the angulation that is necessary to obtain an optimum angle of incidence depending on the inclination of the upright.

- A. The vertical upright requires almost a right-angle bend.
- B. The upright leaning towards tooth requires a much less acute bend.

Figure 5 demonstrates methods of gaining retention.

- A. Modified C bars inclining mesio-distally provide equal stabilisation and more retention and tripping action than the T bars in B because they operate as "push" type retainers at an optimum angle of incidence (see Figure 2 A). Bearing points in A can straddle linguo-approximal angles to include both undercuts. Such retainers are advantageous in teeth lacking much undercut.



- B. T bars maintain stabilisation but give less retention than A and have no tripping action. Retention is no greater than that of horizontal or diagonal clasps which operate like the "drag" type. More suitable for long bell-shaped teeth where increased retention is not needed.
- C. These bars maintain stabilisation but give less retention than A and have no tripping action. Retention is no greater than that provided by T bars assuming that the T bars engage equivalent undercuts.

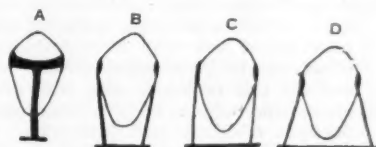


Figure 6 demonstrates the retention afforded by four different types of clasps.

- A offers more retention than B or C because of its shorter lingual crossbar.
- B offers less retention than C, A or D.
- C offers less retention than A or D.
- D is the only one of the four where a tripping action is developed because of the angle of incidence.

Although A, B and C look like "push" types they operate as "drag" types because of their lack of angle of incidence. A is really a circumferential clasp, B and C are vertical bars occupying neutral zones where there is no tripping action.

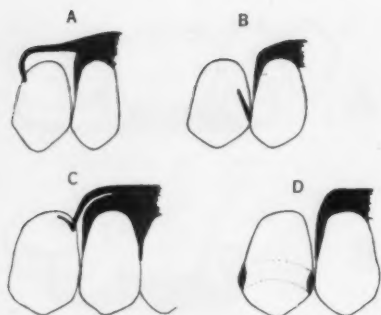


Figure 7 shows four ways of clasp an upper cuspid.

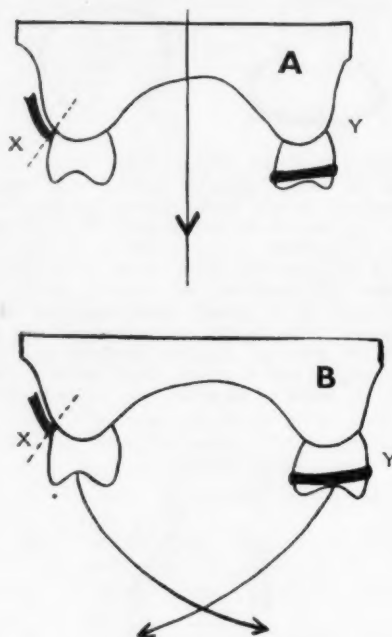
- A. An L bar gives maximum retention because its angle of approach to the plane of the undercut gives maximum tripping action. Because of its poor aesthetics it can only be used when a high lip line exposes only the incisal third of tooth.
- B. An I bar which has no tripping action, poor retention and poor stabilising effect. Such a bar is useful as a reciprocating arm to prevent rotation of a tooth when other teeth give all the retention needed.
- C. A de Van type retainer. Such a clasp offers good retention with considerable tripping action. It is much more aesthetic than A and has a very good stabilising effect.
- D. A mesio-distal clasp which gives moderate retention although it has no tripping action and very little stabilising effect. Its aesthetic effect is very good and for this reason is used most often on upper cuspids. It is a compromise between efficiency and aesthetics. To get the maximum efficiency possible with this clasp the attachment to the saddle should be well to the distal (or mesial) of the tooth so that the free end can be as flexible as possible. To have the attachment in the middle of the clasp as in Figure 6A means that the clasp has two semi-rigid arms which are much less efficient than one flexible arm.

Figure 8 demonstrates the effect of line of withdrawal upon retention.

- A. When the line of withdrawal of a denture is vertical, the bar clasp at X tends to dig into the undercut causing a tripping action because the arm approaches the undercut at an angle to the line of

withdrawal. The horizontal clasp at Y slips off more easily than the bar clasp because undercut plane is parallel to the long axis of clasp arm.

- B. When the denture is rotated from the mouth, the bar clasp at X, being more parallel to the line of withdrawal (and

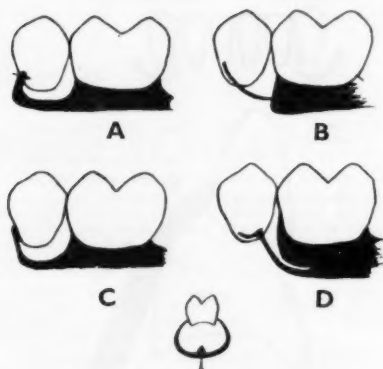


therefore the plane of the undercut more at right angles) blocks movement more positively than in A. The horizontal clasp at Y slips off more easily because the undercut is still parallel to the long axis of the clasp arms.

In this diagram, the two arrows represent two separate lines of withdrawal of different dentures.

Figure 9:—design of clasps.

- A. Bar clasp approaching from correct angle to ensure maximum tripping action and stabilisation.
- B. Although this is a bar clasp, the angle of approach is wrong so that there is no tripping action and consequently very little retention. Also the mass of the clasp is insufficient which would result in early fatigue.



- C. A bar clasp in which all factors except the angle of approach are correct. This would give no tripping action and there would be poor retention.
- D. A de Van type of retainer. It is practically as efficient as A and is useful in cases where a high buccal fold is present. The cross section shows the line of withdrawal of these four clasps.

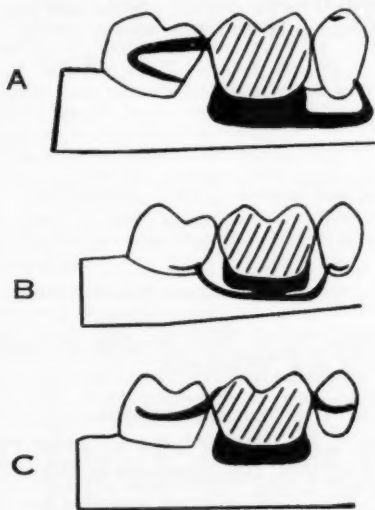


Figure 10 shows three designs for a saddle when the molar is greatly tilted.

- A. An L bar on the bicuspids gives very good retention and an inverted C bar on the molar, although a horizontal type, gives reasonably good retention and is often useful when the tilt of the molar is so great that the use of a bar clasp is very awkward.

- B. De Van retainers can be used very effectively in these cases if the tilt of the molar is not too extreme.
- C. The horizontal type of clasp in these cases is not efficient as there is no undercut on the disto-buccal angle in which to place the free end of the clasp.

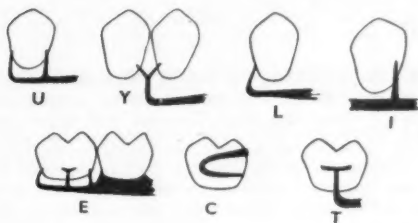


Figure 11 demonstrates designs of clasps.

The L bar is probably the most useful of all retainers.

The I bar is too short and rigid to give much retention and its main use is as a reciprocating device.

The inverted C clasp is of great use on molars which have a considerable mesial tilt and when it is difficult to get access to the mesial undercut with bar clasps.

The T bar gives stability to the denture but unless the tooth is bell shaped does not give great retention.

The U bar gives great stability but because of the incorrect angle of approach to the plane of the undercut it does not give very much retention. Retention can be greatly improved by curving the arms so that they approach the undercut at the optimum angle of incidence, which turns the U bar into a double C bar.

The Y bar is sometimes useful in those cases where there are two short bicuspids neither of which has much undercut. The arms of the Y, approaching the two teeth almost at right angles to each other, make full use of whatever undercut can be found.

The E bar gives the greatest amount of stabilising effect—indeed much more than is usually needed. The retention comes from the L bar section of the clasp.

Figure 12 describes a de Van clasp which is occasionally of use when retention is needed on a central incisor. The arm is carried gingivally from the distal of the artificial central

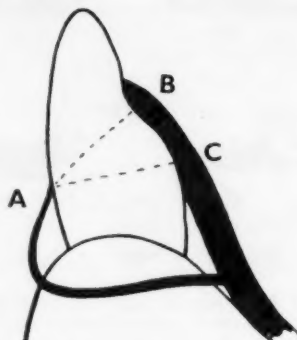
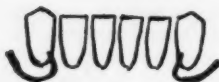


and rests on the free end of the mesial of the natural left central incisor giving a neat retainer when the high lip line will allow its use.

Figure 13 illustrates how two L bars can be used to give a semi-stress breaking effect in a lower denture when only six anteriors are standing.

By placing the continuous retainer on the lingual slopes of the cuspids sufficiently low so that the cingula will not act as stops, the lingual continuous retainer can slide gingivally when masticating force is applied to the saddles.

When this happens, the distance between the free end of the L bar, and the continuous



retainer on the lingual, increases as shown by the dotted lines. When the masticating force is released, because the L bars have good resiliency they tend to recover their original position thus causing the lingual continuous retainer to slide back up the lingual slope of the cuspid to its original position and removing pressure in the saddle areas.

Information from the Dental Board

The following matters are reported from the meeting of the Dental Board of New South Wales, held on July 28, 1954.

The Registrar announced that no change in its constitution had occurred by reason of the recent election. Dr. Baird was congratulated on his re-appointment as President.

APPLICATIONS FOR REGISTRATION.

Benson, Neville Peel, B.D.S., Uni. Syd., 1951; Ewin, Colin Albert, B.D.S., Uni. Syd., 1954; Green, Neville, B.D.Sc., Uni. Melb., 1952; Morrow, William Alison, B.D.S., Uni. Syd., 1954.

ADDITIONAL QUALIFICATIONS.

Richard Leslie Mobbs was given permission to use the letters M.D.S., in connection with his practice of Dentistry.

Sydney Levine was permitted to describe himself as a "periodontist."

FOREIGN DENTISTS.

The application of Miss E. J. de Vries, Utrecht, 1927, for recognition of this certificate was refused.

ILLEGAL DENTISTRY.

The Board decided that it was not prepared to recommend any reduction or remission of a fine recently imposed upon a dental mechanic.

REGULATION 29 — ASSISTANTS.

It was noted that Mr. G. S. Hewlett was employing Mr. H. Crofts.

Editorial

This journal is published by the Australian Dental Association (New South Wales Branch), B.M.A. House, 135 Macquarie Street, Sydney. Communications concerning literary matter should be addressed to the Editor and all advertising and business matters directed to the Secretary.

Subscription rate is £1/5/- per annum (Aust.); £1/10/- per annum outside Australia. Single copies, 5/-.

*Original communications: Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. Carbon copies should not be sent. References should be placed at the end of the article and should include, in the order given, name of author, title, journal, volume, initial page of article, month and year; e.g., Wallace, J. S.—The newer knowledge of hygiene in diet: *Dent. Items Int.*, 69:38 (Jan.) 1947. References to books should include the following information: name of author, title, edition, place of publication, name of publishers, year and page (if necessary).*

Illustrations: These should be kept to a minimum. Suitable captions with number and author's name should be marked on the back of all illustrations. Photographic prints should be approximately 5 in. x 4 in. and printed on glossy paper. Authors unaccustomed to preparing drawings and photographic prints for reproduction are invited to seek the advice of the Editor.

All expressions of opinion and all statements of supposed fact are published on the authority of the writer over whose signature they appear and are not to be regarded as expressing the views of the Australian Dental Association.—H. R. SULLIVAN, Editor.

A New Dental Health Competition

During the past months the co-operation of the dental profession in the State of New South Wales was sought by the Dental Health Education Committee of the Australian Dental Association to assist in the promotion of a new dental health competition. Through the generosity of Mr. L. O. Bailey, president of the Youth Welfare Association of Australia and founder of Hopewood House, valuable prizes were offered for the boy and girl, aged twelve years, who had the best teeth. The standards to be used by the judges are absence of caries, periodontal lesions and malocclusions coupled with the practice of a good standard of oral hygiene. The profession has assisted particularly well by examining children without a fee in order that they might enter this competition.

A most gratifying number of entries were received (approximately 250 girls and boys) and the judges will shortly examine personally those children chosen as finalists in order that the prizes may be awarded during Health Week. Children aged twelve years were chosen as the competitors as it was felt that by this age the majority would have lost their temporary teeth and would all possess a number of permanent teeth which would have been exposed to oral influences for some years.

It is hoped that by the holding of such a competition the interest of both the parents and children will be stimulated in instituting and maintaining good habits to preserve the teeth. We know all too well the unfortunate level to which such standards have gone. A survey, carried out some years ago on the school children of Sydney, indicated that by the time a child reached the age of eight years he was suffering from dental caries.

It would appear from another survey being conducted by the Institute of Dental Research this year that the standards have not improved in any way. Indeed the existence of carious teeth has become accepted as being a normal occurrence and the search for children worthy of being prize winners in this competition is closely akin to looking for a needle in a haystack.

What a sad commentary it is on our way of life to think that one has to search through the children of this State looking almost in vain for one who, dentally, is normal.

It is fortunate too for the other children that the children living at Hopewood House were barred from entering this competition, for of the eighty-six children at the home, thirty-five are caries free, the average D.M.F. figure being 1.5 teeth per child. Whilst great care has been lavished on them during their upbringing, they have received nothing that any other child might not have. Genetically their background is mixed and they usually came to Hopewood as small babies; therefore the prevention of caries must be a post-natal effort. Their diet consists mainly of wholemeal bread, biscuits and porridge, wheat germ, fruits (fresh and dried) vegetables (cooked and raw), butter, cheese, eggs, milk and fruit juices. The obvious exceptions are sugar and refined carbohydrates.

Perhaps the day will come when the present depressing cycle will pass and we may be able to convince the public of the need to include in their diet, foods other than those which have been mashed, seived, deprived of their innate nutritive properties and laden with refined carbohydrate. However, until it does, assuredly we shall be able to continue to hold such interesting competitions.

Dental Materials

Current Notes No. 27*

"Dental Researcher, Physicist and Criminologist"—these terms have been used to describe Dr. Wilmer Souder, who recently retired after nearly forty years association with the National Bureau of Standards, Washington. They indicate the three overlapping roles in which he distinguished himself.

Of greatest interest to the dental profession is Souder's outstanding work in the science of dental materials, in which field he became known as the "father of the renaissance." He developed the renowned dental laboratory at the Bureau, thereby assisting to revive the spirit of research so well exemplified by Dr. G. V. Black in the previous century.

Through some work on dental amalgam alloys carried out on behalf of the U.S. Forces during the 1914-18 war, the value of research and standardisation of dental materials was recognised. The programme was then extended to casting materials and, with the establishment of a Fellowship at the Bureau by the American Dental Association, it eventually covered all aspects of dental materials. The field of work at the Bureau has more recently been widened to include the application of scientific techniques to problems associated with tooth structure.

Souder has written many papers on dental subjects and, with Dr. G. C. Paffenbarger as joint author, his 222-page publication "Physical Properties of Dental Materials," modestly called "Circular C433," has become a classic of its type. It sets forth the results of basic research which had been conducted, chiefly at the Bureau, up to that time (1942).

In establishing a dental research section, Souder had to overcome many difficulties. He once wrote:

the first reactions to the dental research programme at the National Bureau of Standards were far from enthusiastic. Dentists thought they saw another source of disturbance and uncertainty. Manufacturers feared added wrangling with dentists and the further development of small independent and possibly unreliable manufacturers who might take much of their business from them.

We know that these fears have proved quite groundless, not only with the profession, but also with the dental trade for, quoting Souder further,

so far as the manufacturers are concerned let it be said here that this standardisation of materials has given the manufacturer of the better grade products his first effective protection from the encroachments by manu-

facturers of inferior products which everyone realizes can be produced and sold for less than first quality products.

It was fifteen years or so before a laboratory with similar functions was established in Australia and there can be no doubt that Souder and his colleagues greatly assisted in paving the way. The present Commonwealth Bureau of Dental Standards owes much to the example set by the Dental Research Section at the U.S. Bureau and still receives willing assistance and advice from it. The aims of both laboratories, which appear to have no national counterpart elsewhere, may be summed up in Souder's words:

all dental reports from the Bureau of Standards may be regarded as pointing to one ultimate goal: proper materials, properly used.

For his extensive contributions to the science of dental materials, Souder was awarded a medal and citation by the U.S. Department of Commerce in 1951. He is an honorary member of the American Dental Association and an active member of the International Association for Dental Research.

By training, Souder is a physicist and this is reflected in the fact that before his association with dental materials he was in charge of the Thermal Expansion Section at the Bureau. In 1946 he was promoted to Chief of the Metrology Division and at his retirement he held the title of "Consultant, National Bureau of Standards".

Souder's role of criminologist was not so widely known in this country until the reference to him in *Reader's Digest* (October 1951) as "Washington's Detective X". He has had outstanding successes in helping to solve crimes, perhaps the most prominent case being that of the Lindbergh kidnapping. His work in this field is an excellent example of scientific methods in criminology.

His thoroughness in testing is exemplified by the story of the bullet-proof vest. A Government order for the vests had been held up because Souder had claimed there was a weak spot in them. An irate representative of the manufacturer called and, donning a sample vest, insisted that Souder take a couple of shots at him. Souder fired one shot at such an angle that the bullet penetrated far enough to break some vulnerable fastenings causing the vest to come right off. "Want me to take that second shot?" asked Souder!

*A tribute from the Commonwealth Bureau of Dental Standards.

News and Notes

Obituary

Ralph Tompson

It is with deep regret that we record the tragic and untimely death of our colleague and friend Ralph Tompson.

Educated at Sydney Grammar School, after a distinguished scholastic and sporting career, he followed his father into the profession of dentistry, graduating as B.D.S. with Class II Honors in 1931. After some years in the country he set up as a general practitioner in Challis House, Sydney. Here he established an extensive and ethical practice.

In 1943 he joined the R.A.A.F. Dental Corps and concentrated on Periodontia. Many service men and women have good cause to remember his skill and efforts on their behalf. On his discharge he decided to specialise in Periodontia, and took rooms in Macquarie Street, where he soon built up a fine practice.

Elected to the A.D.A. Executive in 1946, he served on many committees being Chairman of the Library, Journal and Dental Health committees. This latter office he held for six years, and under his able leadership extensive and valuable educational work was planned and carried out. The outstanding Dental Health Exhibit at the last Dental Congress held in Sydney, was a fitting tribute to his chairmanship.

His colleagues will remember his capacity for work, and will miss his steadfastness, his attention to and demand for detail, his ability to weigh the pros and cons of any question, and his refusal to support anything that was only "good enough."

Ralph Tompson's ideals of service to the profession and the public were great, a fitting example for us all to follow.

We offer our deepest sympathy to his family in their tragic loss.

Alan Stuart Henderson 1898-1954

On May 24th, the dental profession lost a good and loyal friend and a stout supporter of its ethics and principles by the death of Alan Stuart Henderson. From Sydney Grammar School he volunteered for service in the 1914-18 war at the age of nineteen and saw two and a half years' service with the 5th Field Artillery Brigade in France and Belgium, finishing with the rank of Lieutenant. He remained on reserve between wars.

He graduated into the dental profession in 1922 and commenced practice at Lindfield in 1923. The same year he was appointed an honorary dental surgeon at Royal North Shore Hospital and he retained that appointment up to the time of his death.

A member of the Executive of the N.S.W. Branch of the Australian Dental Association from 1934-1936, he was chairman of the Sports and Social Committee and served on the Dental Health Education Committee for several years. He was Vice-President of the Northern Suburbs Dental Group.

He volunteered for active service in the Second World War and was with the 9th Field Ambulance for two years including six months in New Guinea.

Only those more intimately associated with him knew how great was the physical and nervous toll of the two wars, a toll hidden from the world in the tradition of proud Scottish ancestry.

A man of many friends, he was a member of Killara and Elanora Golf Clubs, the University Club, Newport Life Saving Club, Newport Bowling Club, the Dental representative on Chatswood Rotary Club and a member of the Roseville Branch of the R.S.L. League.

A patriotic citizen, a loyal, generous and staunch friend he will be remembered by many for his work for Legacy on A.I.F. Golf days. He is greatly missed by a wide circle of friends and intimates, many of whom were amongst the very large and representative gathering to pay tribute at his funeral service.

To his widow (nee Bella Hays) whom he married in 1923, we extend the deepest sympathy at the loss of a true partner.

"Vale" loyal friend and patriot.—L.S.B.

University of Sydney Post-Graduate Committee in Dental Science

Members of the profession are notified that there are a few vacancies in the following post-graduate course:—

Course No. 44: Inlays.

8th November, 1954, to 12th November, 1954.

Fee for course—£12/12/-.

Clinicians: Mr. W. A. Grainger, M.D.S. and Dr. E. H. Bastian.

The course will comprise instruction on principles of inlay cavity preparation, advanced design of preparations for special purposes, pinlays, pinledge, three-quarter veneers

and full cast crowns. Hydrocolloid and other indirect impression techniques, construction of dies and casts for cases involving multiple restorations, vacuum investing and casting techniques will be included. Instruction will also be given on the handling of waxes, investments and selection of gold alloys.

Application for enrolment with the above course should be made to the Secretary, University of Sydney Post-Graduate Committee in Dental Science, Dental Hospital of Sydney, Chalmers Street, Sydney.

Annual Sports Day

The annual Sports Day of the Association was held at The Lakes Golf Club on Thursday, 15th July, 1954. A large number of members of the profession took advantage of the excellent weather to enjoy a most successful sporting and social function.

Golfers competed for the Sir Harry Moxham Cup and bowlers for the J. V. Hall Best Bowls Trophy.

The results of events held during the day were as follows:

GOLF.

Sir Harry Moxham Cup:

Mr. J. Howell-Price, 5 up.

Runner-up:

Mr. E. Ryan, 4 up.

A. Grade:

Mr. T. Royle-Smith, 1 up.

B. Grade:

Mr. G. Morse Withycombe, 1 down.

C. Grade:

Mr. R. Thompson, 2 up.

1st Nine:

Dr. J. D. Oddy, 4 up.

2nd Nine:

Mr. J. Gillies, 3 up.

4-Ball Best Ball:

Winners: E. Hey, R. Ratcliffe.

Runners-up: J. Gillies and E. Ryan.

Long Drive:

Mr. V. Golden.

BOWLS.

J. V. Hall Best Trophy:

Winners: W. Mitchell, J. Hogue, T. Dunphy and J. L. McDermott.

Runners-up: V. Slocombe, L. Burgess, S. Fox and R. Chappell.

Flavelle Cup—1954

The 26th Flavelle Golf Cup was played at Manly Golf Course on 26th August, 1954. A field of 141 golfers took part. Bowls was played and attracted 36 players.

The following members of the profession were trophy winners:

GOLF.

Flavelle Cup:

Winner: A. G. H. Lawes (17) 1 up.

Runner-up: R. Bowerman (18) 1 up.

Best Scratch Score:

E. Bastian, 4 down.

Country Trophy:

K. Cantwell (18), 3 down.

Handicaps:

12 and under: F. Holt (11) 1 down.

13-15: A. S. Binns (14) square.

16-18: K. O. Binns (16) square.

4-Ball Best Ball:

Winners: R. Bowerman (18) 10 up and J. Hardwick (11).

Runners-up: A. French (8) 5 up and A. Carr (14).

BOWLS.

G. Martin, W. L. Mitchell, J. L. McDermott and J. O. Stenmark.

Association Activities

Australian Dental Association New South Wales Branch

GENERAL MEETINGS.

At the general meeting for the month of July, held on Tuesday, 27th, a composite lecture entitled "The Practical Control of Dental Caries" was presented to members by Dr. N. E. Goldsworthy and Dr. H. R. Sullivan, Director and Assistant Director of the Institute of Dental Research, United Dental Hospital of Sydney and Mr. Robert Harris, Head of the Department of Preventive Dentistry, United Dental Hospital of Sydney.

This comprehensive analysis of modern thought as to the causation and prevention of dental caries was much appreciated by all members attending.

New Zealand Visitor.

At the general meeting on 17th August, 1954, an overseas visitor in the person of Mr. E. Brebner gave the address.

Mr. Brebner, who is Principal Dental Officer (Health Education) Division of Dental Hygiene in New Zealand, was returning to duty after an extensive overseas tour on which he investigated dental health education in the various countries he visited.

Mr. Brebner's address on "Dental Health Education in Practice" proved most instructive. The text of this lecture will be published in a later issue of this Journal.

EXTRAORDINARY GENERAL MEETING

An extraordinary general meeting of the Association was called by the Executive on 2nd September, 1954, upon the requisition of 30 members of the Association to consider the question of a referendum and other matters in regard to the courtesy title of "doctor" for the dental profession.

The meeting was chaired by the President, Dr. F. E. Helmore in the presence of 203 members. The Chairman briefly outlined to the meeting, consideration given to proposals put before it by various members and professional bodies for the use of the courtesy title of "doctor" by dentists. He indicated that the matter had been referred to the Dental Board of New South Wales and the Association had been advised that the Board could see no reason to warrant it taking any action as desired.

The Chairman read to the meeting opinion of Queen's Counsel which indicated that under existing legislation the Board did not have the power to act as so desired in the proposals placed before it, and that resolutions advanced by the requisitionists for the meeting were out of order and, in the form presented on the notice, beyond the competency of a general meeting.

The Chairman told the meeting that he had to rule resolutions contained in the notice paper and advanced by the requisitionists beyond the competency of the meeting but that he was prepared, in order to allow adequate discussion, to accept an appropriate amendment to the first resolution.

A resolution was moved that the Executive give further consideration to this matter and report to the Annual General Meeting of the Association. After considerable discussion this motion was put to the meeting. A poll was taken and the motion defeated.

EXECUTIVE REPORT.

Second Country Convention, Orange.

As this Journal goes to print the Second Country Convention of the Association will be

in session at Orange, New South Wales. The many members of the State Branch attending will no doubt enjoy the comprehensive clinical and social programme so ably arranged by the Convention Commission which has been drawn from the members of the Western Division of the Association.

Casual Vacancy on the Executive.

Consequent upon the unfortunate death of Mr. Ralph Tompson, the Executive, at its meeting on 19th July, 1954, appointed Dr. J. V. Hall Best to fill this casual vacancy under the terms of Article 26 of the Articles of Association.

Dental Technicians' Award.

The Executive wishes to report that the Dental Technicians' State Conciliation Committee has completed its consideration of a new Dental Technicians' State Award. The formalities concerning the finalisation of the award are almost complete.

Conditions of the award are substantially those pertaining under the former award, as varied from time to time.

Full details will be advised to members when complete finality has been reached.

Courtesy Title of Doctor for Dental Profession.

Correspondence has been received by the Executive from various members and certain Suburban Dental Organisations concerning the granting and use of the courtesy title of Doctor by members of the dental profession in New South Wales. The Executive forwarded all of the material contained in the correspondence to the Dental Board of New South Wales, which, it is understood, was itself approached in the matter.

The Executive wishes to advise that is now in receipt of a letter from the Dental Board of New South Wales which indicates that the Board "is of the opinion that in view of all the relevant circumstances the arguments adduced in favour of the use of the courtesy title of Doctor do not warrant the Board taking any action towards the adoption of this title by dentists."

The Executive has also taken Counsel's opinion which states that the Board could not authorise such a generalised use of the title of Doctor as desired.

A resume of the activities of the Executive in this matter, together with the full legal opinion referred to above was presented to an extraordinary general meeting of the Association on 2nd September. This extraordinary general meeting was called upon the requisition of the appropriate number of members.



*Announcing the latest in
x-ray dental units the*

KONRAD 10

A robust dental unit designed to give a life-time of use and produce quality radiographs right throughout your professional career.

Modern and attractive in appearance the Konrad 10 has been designed to fit into any surgery owing to the hinged retractable ampoule supporting arm, which folds back against unit after use.

The light weight of the unit makes the movements to and from the dental chair almost effortless.

The Konrad 10

Low in Price

High in Intensity

Increases Income



**WATSON VICTOR
LIMITED**

9-13 Bligh Street,
SYDNEY

TELEPHONES: Sydney BW 4433; Melbourne JA 3146; Adelaide W 2246; Brisbane B 1616; Perth BA 9131; Newcastle B 1054; Hobart B 6310. NEW ZEALAND: Wellington 42-095; Auckland 31-710; Christchurch 75-983; Dunedin 14-090.

Say you saw it in "The Dental Journal of Australia"



The pivot on which every tooth service turns is the teeth that make fine denture service possible. Because New Hue Teeth offer you so many exclusive and distinctive advantages, we long ago made New Hue Teeth the pivot of OUR Tooth Service. And we support New Hue Stocks with trained personnel who KNOW teeth. Just how dependable our Tooth Service is, is evidenced by the many dentists who, when they want teeth, just naturally call upon us.

KEMP & LIDDELL PTY. LIMITED

"Newlands House"

Phone : MA 6631 (4 lines) — 141-143 ELIZABETH STREET, SYDNEY



KAVO

HANDPIECES

THE PEAK OF PERFECTION

for Slipjoint
or Doriot

AVAILABLE FROM
ALL DENTAL DEPOTS

Complete Spare Part Service

Sole Wholesale Distributors:

RUDOLF GUNZ & CO. PTY. LTD. 131 MACQUARIE ST., SYDNEY. BU 2410
107 COLLINS ST., MELBOURNE. FA 8473

CO-AG and CO-AG-SED

CLINICALLY-PROVED
DENTAL HAEMOSTATICS

- Fully proved by clinical test, for the prophylaxis and treatment of dental haemorrhage.
- Co-Ag is orally administered and quick in action.
- Non-toxic, non-irritant, entirely reliable.
- Co-Ag gives positive haemorrhage control.
- Co-Ag-Sed quickly relieves post-operative pain.
- Co-Ag-Sed allays natural stiffness and soreness.

CO-AG and CO-AG-SED are indispensable to the busy practitioner. They are available from Chemists and Dental Depots.

MEDICUS LABORATORIES

73 YORK STREET, SYDNEY. Phone: BX 1931.

For Positive Control of Haemorrhage and Relief of Post-Operative Pain and Soreness.

Use, and prescribe with confidence, CO-AG and CO-AG-SED.

**MEDICUS
PRODUCT No. 2
CO-AG
FOR PREVENTION AND
TREATMENT OF
DENTAL
HAEMORRHAGE**

**MEDICUS
PRODUCT No. 3
CO-AG-SED
TO RELIEVE
DENTAL PAIN
AND CONTROL
HAEMORRHAGE**

Say you saw it in "The Dental Journal of Australia"



Drop for Drop

XYLOCAINE[®] HYDROCHLORIDE

ASTRA

(Brand of lidocaine hydrochloride)



invites clinical comparison with any other local anesthetic commonly employed in modern dentistry for local anesthesia that is extremely rapid in onset, deeply profound, widely diffused and of adequate duration (1). Minimal volumes are sufficient for routine procedures.

Stocked by leading dental supply dealers as a 2% solution without epinephrine and with epinephrine 1:80,000 or 1:50,000 in 20 cc. and 50 cc. multiple dose vials. Also available in 1.8 cc. cartridges with epinephrine 1:80,000, packed 25 cartridges to a vacuum sealed tin.

Use Xylocaine Ointment, the new topical anaesthetic.

Manufactured by

A. B. ASTRA, Sweden

Sole Australian Distributors

**COMMONWEALTH DENTAL
SUPPLY Co. Pty. Ltd.**

(1) Supporting bibliography of reference of over 220 scientific papers available on request.

R. Xylocaine is a registered trade mark.

Say you saw it in "The Dental Journal of Australia"



Latest development by
the Dentists' Supply Co.
of New York.

Widely acclaimed in the
U.S.A. and many other
parts of the world.

Now manufactured in
Australia.

**A
NEW STANDARD
OF EXCELLENCE**

Sole Wholesale Distributors

THE AMALGAMATED DENTAL (Aust.) PTY. LTD.
Melbourne **Sydney**

Say you saw it in "The Dental Journal of Australia"

There's a



PHILIPS

"Oralix"

**suitable for
every surgery**

Rarely indeed has superb radiographic performance and operative flexibility been merged so successfully as in Philips "Oralix." Adaptable to the extreme, you can choose a model to suit exactly the needs of your surgery. For example the lightweight pedestal model is ideal for the larger surgery. Where space is a consideration of importance you can choose the dental instrument unit, the dental chair model or the wall bracket model.

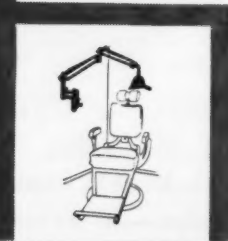
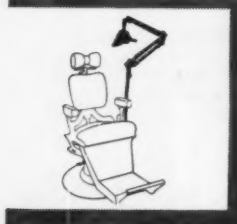
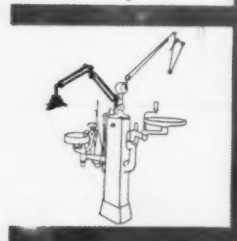
No matter which you specify, you will find in the "Oralix" an instrument remarkable for its accuracy, reliability and ease of operation—all attributes that Philips traditional standards always ensure.

For full technical details write to



**PHILIPS ELECTRICAL
INDUSTRIES PTY. LTD.**

SYDNEY: 69-73 Clarence Street
MELBOURNE: 590 Bourke Street
BRISBANE: 148 Edward Street
ADELAIDE: 119 Grenfell Street
PERTH: 381-5 Murray Street



Say you saw it in "The Dental Journal of Australia"

PG15-53

Dental, Medical, and Technical Printing

**YOUR STATIONERY . . . should
Reflect the Dignity of your Profession**

When requiring Memorandum of Fees Forms, Record Cards or any kind of printed stationery, ask for our representative to call—we can assure you of quality and distinction at a moderate price.

Technical printing receives our special attention, and our extensive and exclusive range of matrices for the printing of formulae, Greek and mathematical signs and tabular matter enables us to execute this class of work at economic prices.

SIMMONS LIMITED

32 PARRAMATTA ROAD (Opposite University Oval) GLEBE.

Phones : MW 2676 (4 lines).

For your patients' comfort and cleanliness

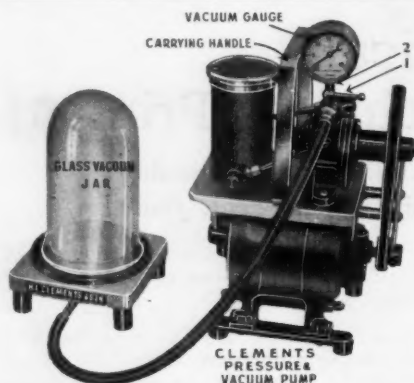


SANOS PTY. LTD.
206 Carlisle Street, Balaclava, Vic.

Sanos Denture Paste combines the most modern antiseptics to destroy bacteria, and the most modern detergents to remove mucin plaque. Nothing can make plates cleaner and more comfortable than brushing . . . with Sanos.

. . . recommend brushing with SANOS

Say you saw it in "The Dental Journal of Australia"



CLEMENTS' VACUUM INVESTING MACHINE

Vacuum Investing will give castings for Inlays or Partial Dentures that are consistently free from surface defects.

Wasted chairside time in fitting inlays is completely eliminated.

The Pump Unit can also be used (1) as an Aspirator, (2) for supplying low pressure air for blowpipe, etc.

H. I. CLEMENTS & SON PTY. LTD.

62/64 Pacific Highway, St. Leonards, Sydney.

Manufacturers of Scientific Equipment.

Phone: JF 1992.
Established 1908.

Again available for your child patients!

Gibbs S.R.

GOOD TEETH CERTIFICATE

with its delightful Alice in Wonderland characters designed in full colour by Walt Disney.



For your free supply of certificates write to
"Certificate," Box 1590, G.P.O., Sydney

SR68.34

Say you saw it in "The Dental Journal of Australia"



For unwanted bleeding in dental surgery

An absorbable haemostatic

Gelatine Sponge A & H has a particular application in dental surgery for those cases of primary and secondary bleeding which are undesirable and which are often difficult to control by ligation. It minimises blood loss and, because it is completely absorbed, obviates the necessity for subsequent removal from the site of application.

Gelatine Sponge A & H . . .

- (1) Completely effective as a hæmostatic.
- (2) Does not inactivate, and can be used in conjunction with antibiotics such as penicillin or streptomycin.
- (3) Consists only of purest Gelatine, therefore of animal origin and thus tendency to foreign body reaction is reduced to a minimum.
- (4) Is readily absorbed by the normal action of Phagocytosis.
- (5) Is transparent to X-rays.
- (6) Is pliable and can be moulded easily to any shape or size.
- (7) Is stable to heat and has been sterilised by heat.
- (8) Value in Dental Surgery proved by widespread trials by prominent Dental Surgeons in many countries throughout the world.

It is supplied sterile in four sizes.

- No. 1. Strips 2cm. x 6cm. x 0.7cm. in glass tubes each containing one piece; packages of six.
- No. 2. Strips 10cm. x 20cm. x 0.1cm. in glass tubes each containing one piece; single tubes.
- No. 3. Thin Wafers 2cm. x 2cm. x 0.1cm. in glass tubes each containing six pieces; packages of six.
- No. 4. Envelope containing one piece 10cm. x 10cm. x 0.5cm.

GELATINE SPONGE A & H

Literature and fullest information will gladly be furnished on request.

ALLEN & HANBURYS (AUSTRALASIA) LTD.

REGISTERED OFFICE, N.S.W.: 418 ELIZABETH STREET, SYDNEY

SURGICAL INSTRUMENT SHOWROOMS: 41 HUNTER STREET, SYDNEY

AH. 34.FP

FREE DELIVERY TO ALL STATES

(ESTAB. 30 YEARS)

*"For Quality and Economy
in all your Printing."*

LAWSON & BRAY (Sales)

*All kinds of Dental
Stationery and Chart Cards.
Let us know your requirements
and samples with prices will be sent.*

KEMBLA BUILDING, 58 MARGARET ST., SYDNEY

FJ 1041 (2 LINES)

Patients need advice on **HOW TO CLEAN DENTURES**

A recent survey reveals that many wearers of dentures attempt to clean them with toothpaste, soap or even salt. The fine materials and workmanship of the dentures you supply deserve better care than that.

A word of advice from you on the merits of STERADENT will ensure that your patients keep their dentures clean . . . efficiently and safely.

STERADENT is made specially to oxygen-clean and sterilize every type of denture.

STERADENT, dissolved in water, gives an alkaline solution which releases nascent oxygen, cleans away even the most stubborn tobacco stains and sterilizes every inmost crevice.

Steradent
REGD. TRADE MARK

SPECIALLY MADE FOR CLEANING DENTURES

6197

TRURAY Teeth

The Perfect Substitute for Natural Teeth

AUSTRALIA'S BEST SELLER

TRURAY

present

- MODERN ANATOMIC MOULDS
- SUBTLE CHARACTERISED BLENDING
- FULL NATURAL HARMONY
- CORRECT DEGREE OF TRANSLUCENCY
- PORCELAIN STRENGTH UNEQUALLED

TRURAY Range . . .

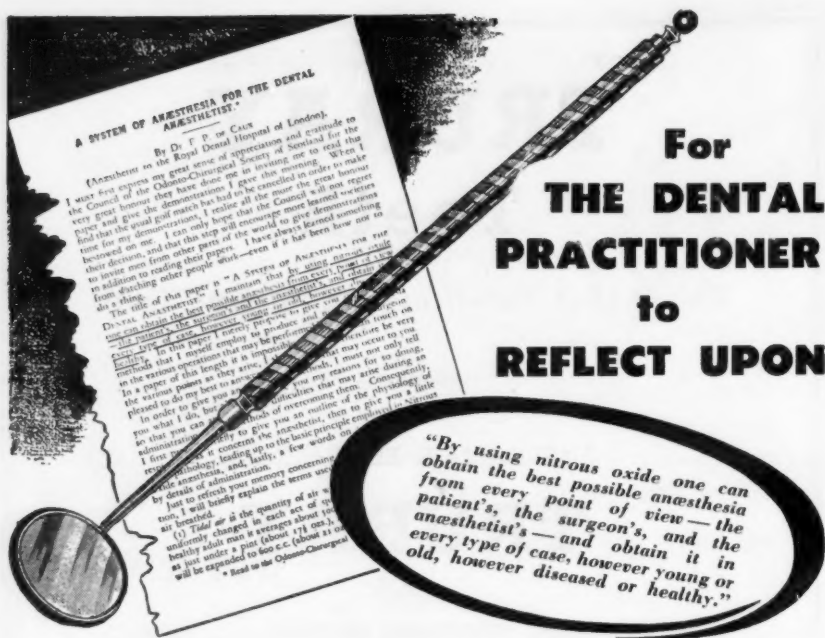
TRURAY ANTERIOR PIN TEETH

- NARROFORM POSTERIOBS
- FUNCTIONAL POSTERIOBS
- ORTHOFORM POSTERIOBS

HARCOURT NEIL PTY. LTD.

154 CASTLEREAGH STREET, SYDNEY.

MA 2840.



**For
THE DENTAL
PRACTITIONER
to
REFLECT UPON**

"By using nitrous oxide one can obtain the best possible anæsthesia from every point of view—the patient's, the surgeon's, and the anæsthetist's—and obtain it in every type of case, however young or old, however diseased or healthy."

The above quotation from a paper delivered to the Odonto-Chirurgical Society of Scotland by Dr. F. P. de Caux, Anæsthetist to the Royal Dental Hospital of London, indicates clearly the reasons for modern dentists' preference for Nitrous Oxide-Oxygen. Increasing use is made of the safe Nitrous Oxide-Oxygen combination from month to month by progressive members of the profession because—

- It reduces patients' fears of difficult extractions and prolonged treatments by ensuring complete freedom from pain.
- It produces no harmful reactions (nausea, coughing, etc.).
- Speedy elimination from the body promotes rapid recovery—a benefit to both patient and practitioner.
- Normal bodily functions are not disturbed.



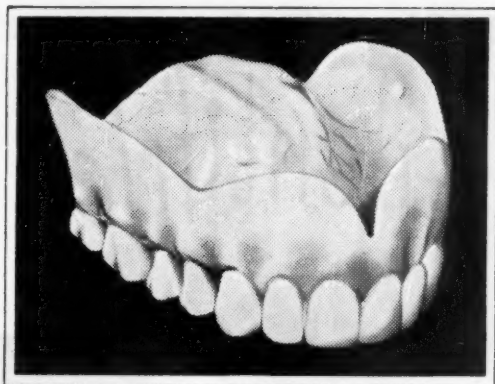
Technical data will be supplied to the profession on request.

THE COMMONWEALTH INDUSTRIAL GASES LIMITED

138 BOURKE ROAD, ALEXANDRIA, NEW SOUTH WALES
OXYGEN + NITROUS OXIDE + CARBOGEN + CYCLOPROPANE + CARBON DIOXIDE

Q.FP

Say you saw it in "The Dental Journal of Australia"



Perfect Craftsmanship ...

but — MOUTH TISSUES CHANGE!

... and that's the trouble, because ignorance of this may cause dissatisfaction with a perfect job. Patients *should know* when normal resorption occurs and realise that this condition requires their dentist's assistance. It is sound business and good advice for the dentist to advise the patient's use of Fasteeth when fitting new dentures. A carefully blended combination of gums in Fasteeth ensures the maintenance of the peripheral seal, making Fasteeth cohesive rather than adhesive. Try recommending Fasteeth to your next denture patient!

NEW FASTEETH PACK

The Fasteeth pack now has a special finger-tight lid. When this is removed, a perforated top is revealed that enables a quick, even, economical distribution of FASTEETH Powder over all parts of dentures that contact the gums and the roof of the mouth. Trial professional samples available on request.



Distributed by

CLINTON-WILLIAMS PTY. LTD.

Rothschild Avenue, Rosebery

FT. 30. PP

Say you saw it in "The Dental Journal of Australia"

BRISTOL-MYERS introduces a

New dentifrice



Whilst Bristol-Myers do not believe that anti-gum disease and anti-carries claims should be made for chlorophyll, they recognise the popular appeal which mouth deodorants have for the average user of dentifrice.

Accordingly, chlorophyll has been added to Ingram Ammonium Ion Tooth Powder which will now be known as *Ipana Tooth Powder*. This powder will therefore combine the University of Illinois' formula with chlorophyll.

In offering this product, Bristol-Myers believe that it combines the best-known anti-carries agent so far incorporated in a dentifrice, with a satisfactory mouth deodorant of considerable vogue.

BRISTOL-MYERS CO. PTY. LTD.

ITPI-53



★ Soluble Aspirin

Disprin is a stable and palatable preparation in tablet form which dissolves rapidly in water to produce a solution of calcium aspirin. Disprin combines the convenience of aspirin with the therapeutic advantages peculiar to calcium aspirin. Being soluble it affords quicker relief than acetylsalicylic acid with a much reduced risk of gastric irritation, even when administered in massive dosage, and being stable it is free from the unfortunate tendency of calcium aspirin to break down into unwanted decomposition products.

DISPRIN

Regd.

WELL-TOLERATED, RAPID IN RELIEF

★ *Disprin tablets readily react in water to form a palatable solution of calcium aspirin.*

RECKITT & COLMAN (AUSTRALIA) LTD. (Pharmaceutical Division), SYDNEY

Say you saw it in "The Dental Journal of Australia"

Royal Australian ARMY DENTAL CORPS

Applications for appointment to short service commissions as Dental Officers in the Australian Regular Army are invited from British subjects resident in Australia and legally qualified in a State of the Commonwealth to practise as dentists or dental surgeons. Appointment is normally in the rank of Captain, but appointment in a higher rank may be made in special cases in which higher specialist qualifications are required of and held by the applicant.

Appointment is for four years with the right to terminate after two years. Dental Officers in the Regular Army will be required to serve in Australia or overseas.

PAY AND ALLOWANCES

RANK	Single Living in Camp	Single Living out of Camp	Married Living in or out of Camp
CAPTAIN	1202	1371	1417
after 2 years	1257	1426	1472
MAJOR	1394	1563	1609
after 2 years	1430	1599	1645

RETIREMENT BENEFITS AND GRATUITY

Conditions as under relative to Retirement Benefits and Gratuity are applicable to Dental Officers serving in the Australian Regular Army only.

Retirement Benefits. Officers are required to contribute to the Defence Forces Retirement Benefits Fund, from which benefits are provided in the event of death or retirement through invalidity during service. An officer who completes his engagement or resigns is entitled to a refund of his contributions to the Fund.

Gratuity. An officer who completes at least two years of his period of engagement and receives no benefit except a refund of contributions to the Fund is entitled to a gratuity of £125 for each completed year of service with a pro rata payment for each additional month of service.

LEAVE, PRIVILEGES

Leave is granted on a basis of a minimum of 18 and a maximum of 30 days per year, exclusive of Sundays and public holidays, according to the officer's area of service. Initial issue of uniform and necessaries is free. Medical and dental treatment, including hospitalization, is free.

Applications should be addressed in the respective States to:—

QLD.	HQ Nth. Command, Victoria Barracks, Brisbane.
N.S.W.	HQ Eastern Command, Victoria Barracks, Paddington, Sydney.
VIC.	HQ 9th. Command, Albert Park Barracks, Melbourne.
S. AUST.	HQ Cent. Command, Keswick Barracks, Adelaide.
W. AUST.	HQ West. Command, Swan Barracks, Perth.
TAS.	HQ Tas. Command, Angelsea Barracks, Hobart.

Further particulars may be obtained from the Assistant or Deputy Assistant Director of Dental Services at any of the above addresses.

THE ROYAL AUSTRALIAN AIR FORCE HAS VACANCIES FOR DENTAL OFFICERS

The Royal Australian Air Force is offering short term commissions with good conditions and pay, to suitably qualified male dentists to serve as Dental Officers.

DUTIES—Successful applicants will be appointed in the Medical Branch. Their duties will include the dental treatment of personnel at R.A.A.F. establishments within Australia and/or overseas and the examination and treatment of recruits on entry. Dental mechanics and trained orderlies are employed in the dental sections which are well equipped with instruments and materials for all types of dental treatment.

QUALIFICATIONS—Applicants must be British subjects of substantially European descent. They must be registered by the Dental Board of any State in the Commonwealth of Australia and be medically fit in accordance with R.A.A.F. standards.

RANK ON APPOINTMENT—A candidate with former commissioned service in any of Her Majesty's Forces will be considered for appointment in either of his former rank or such other rank as may be commensurate with his qualifications, experience and other attributes. For candidates without former commissioned service the minimum rank on appointment will be Flight Lieutenant. Higher rank however, may be determined depending on applicant's qualifications, experience and age.

DURATION OF APPOINTMENT—Duration of a short service commission is four years. However an extension of three years may be granted.

MEDICAL AND DENTAL TREATMENT—Free medical and dental treatment, together with hospitalization is available to all members.

GRATUITY—A gratuity at the rate of £125 per annum will be paid to Dental Officers on completion of four years' satisfactory service. An Officer who resigns prior to the expiration of his commission may be paid a gratuity for time actually served at the rate of £125 per annum, provided that he has completed at least two years' satisfactory service.

PENSION SCHEME—Officers are required to contribute to a pension scheme which provides a retiring allowance and also covers invalidity or death during service. Officers who reach retiring age for rank held will receive benefits as follows:—

20 years service completed—Full pension.

15 years service completed—Pro rata pension according to years completed.

10 years service completed—Return of contributions plus gratuity of 150%.

RATES OF PAY (as at MAY, 1954)

		Single	Married
Flight Lieutenant	...	65/11—71/11 per diem.	77/8—83/8 per diem.
Squadron Leader	...	76/5—82/5 per diem.	88/2—94/2 per diem.
Wing Commander	...	87/11—97/11 per diem.	99/8—109/8 per diem.
Group Captain	...	103/5—113/5 per diem.	115/2—125/2 per diem.

Further particulars may be obtained from the R.A.A.F. Recruiting Officer, DEFENCE FORCES INFORMATION BUREAU, 77 York Street, Sydney, BX6077, or Combined Services Recruiting Centre, Beach Road, Rushcutters Bay, FB 1261. Hours: Monday to Friday, 9 a.m. to 5.30 p.m. Saturday, 9 a.m. to 12.30 p.m.

If unable to call, write to Deputy-Director of Recruiting, Box XYZ, G.P.O., Sydney.



***The VITA LUMIN TEETH with LUMIN EFFECT
are now available in PORCELAIN and ACRYLIC***

The Vita-Lumin teeth have a lifelike appearance by day or night-light.

So no one will notice that your patient's teeth are artificial.

The Lumin-Effect is a Vita discovery and invention patented
No. 742600/49.

Literature, Mould Guides, Mould Charts and Shade Guides on request.

Manufacturers: **VITA TOOTH MFG. CO., Saeckingen, W. Germany**


Sole Distributors in N.S.W. and Queensland:

HARCOURT NEIL PTY. LTD., 154 Castlereagh Street, Sydney. Tel.: MA 2840

Say you saw it in "The Dental Journal of Australia"

October, 1954

LIDOCATON ANAESTHETIC



Lidocaton

LIDOCATON, as an anaesthetic, incorporates the most recent developments and progress in science.
LIDOCATON produces immediate, deep and protracted anaesthesia, with remarkable compatibility.

A trial will convince you.
Doctor's samples on request.

PHARMATON LTD. - LUGANO (Switzerland)
CHEMICAL AND PHARMACEUTICAL PREPARATIONS

Available From All Supply Houses

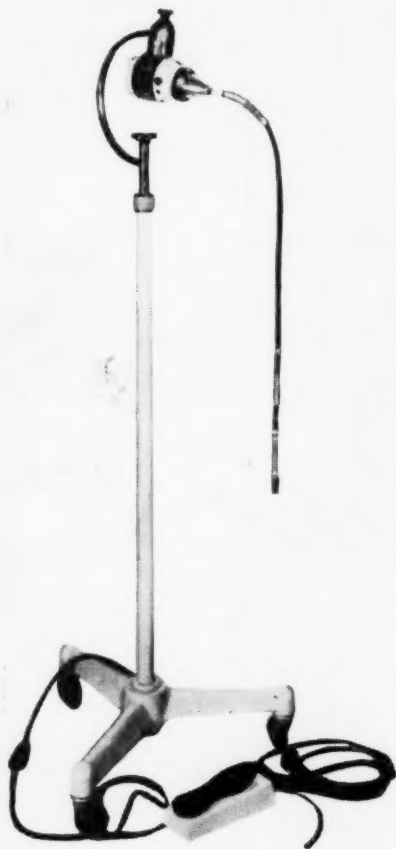
Sole Wholesale Representatives:

AINSWORTH DENTAL COMPANY, AUSTRALIA.

Say you saw it in "The Dental Journal of Australia"

Mobile Dental Engines

Vastly Different and Vastly Superior



These reliable mobile engines can be supplied with either flexible or all-cord arms, and are complete with rotary foot control, giving range of speeds and reverse. Inspection invited.



Also available for immediate delivery:—

**LABORATORY ENGINES WITH
FOOT CONTROL**

Full details available from the noted equipment and furniture house:

The Commonwealth Dental Supply Company Pty. Ltd.

206 CASTLEREAGH STREET, SYDNEY

PHONE: M 4818

Postal address: BOX 1922, G.P.O., SYDNEY

Say you saw it in "The Dental Journal of Australia"

Printed and published for the Proprietors, The Australian Dental Association,
New South Wales Branch, B.M.A. House, 135-137 Macquarie Street, Sydney,
by Simmons Limited, 32 Parramatta Road, Glebe, Sydney, N.S.W.